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and Maintenance of Way

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OUR EXHIBIT

AT THE

International Railway Congress

IS SECTION B

STALL 14

Main Exhibit Building

THE International Railway Congress, which is to hold its seventh session at Washington May 4-13, will be the most important gathering of railway officials ever held in this country. For the first time its sessions will be held in America, and not only delegates from foreign countries will be present, but delegates from all of the leading home roads. Washington next May will undoubtedly see the largest gathering of railways and the railway supply men that has ever been witnessed anywhere. Not only will the subjects discussed in the sessions of the congress be of interest and importance, but the exhibition of American railway supplies will be an education in itself. Every man interested in any way in railways should be in Washington in May.

WE publish in this issue a general description of the new Angus shops of the Canadian Pacific Railway at Montreal. The matter given is that which is of interest to both the engineering and mechanical departments, and those of our readers who are interested in further mechanical details regarding this shop are referred to forthcoming issues of the RAILWAY MASTER MECHANIC. The Canadian Pacific Railway in the building of this shop has put into operation one of the largest and most complete shops in North America. We show in this issue plans of general layout, the electrical distribution and the elevation and cross section of the locomotive shop, together with illustrations showing the structural work in the erecting and machine shops. In future issues will be given a general description of the buildings and yard lay out.

OF special interest to our readers is the publication in each issue of an index of all important articles appearing in the leading railway and engineering journals which are of interest to those connected with railway engineering and maintenance of way department. This index will be found each month among the advertising pages, and it contains references to articles found in the current issues of nearly fifty publications. There is no attempt made to make a digest of various articles published during the previous month, but simply a descriptive index giving the title of the article, the name of the author, an abstract in a few words, when and where published and the number of words contained. There is now being published every month such a mass of material relating to general railroading and civil engineering that it is almost impossible for the average reader to find the time to keep posted on all that is being published, and we shall attempt in this index to do the reading for our subscribers, and present to them in condensed form everything that is published relating to the field of the "Railway Engineering and Maintenance of Way."

BEGINNING with this issue we will illustrate and describe some sand houses and equipment as used on a number of different railroads. These articles will cover the arrangement of buildings as well as the equipment for handling the sand. This feature of railroading has never received the attention that is due it, which may be owing to the fact that it belongs partly in the mechanical and mostly in the engineering departments. As a rule sand houses are part of the coal docks, and while excellent opportunities are afforded for putting in first-class equipment, the greater attention is taken up with handling the coal, probably because there is more of it.

A well equipped sand house is a saving to the company which can be accomplished with a very small outlay. Some civil engineers do not realize that the sand box on a locomotive holds from one to two barrels of sand and that it is not sufficient to have only

a sand stove for drying tht sand, after which a great many carry the sand in coal scuttles to the running board of the engine, when the engineer gives it the remainder of the fifteen feet elevation to the top of the sand box. A very little study of this subject will convince anybody that improvements of this nature are a paying proposition.

THE Frankfurter Zeitung of February 9, 1905, states that all the German harbors of the North Sea are more or less subject to difficulty with soft mud, which fills the channels and basins in a comparatively short time, and requires constant dredging to keep them deep enough for large ships. Wilhelmshaven, the harbor of the German navy, suffers much from this calamity. The draft of modern vessels increases steadily, and therefore it has been very difficult to keep the channel at the necessary depth. In spite of continuous dredging this has not been possible with dredges of the kind heretofore in use. The firm of F. Schichau undertook to construct a dredge which would meet all requirements, and has gained a great technical success. The dredge now delivered is a large steamer of very pleasing shape. The length is 262½ ft., the width 47½ ft. and it is therefore the largest dredge existing. Its prformances are surprising. After a short trial of the machinery the vessel proceedd from Danzig to Wilhelmshaven and began its trial dredging in the latter part of December, 1904. The contract called for 3,000 cubic meters (3,924 cubic yards) per hour in soft ground. The dredge easily made 5,000 cubic meters (5,450 cubic yards). The 3,600 cubic meters required for soft mud it performed even in heavy sandy soil of 1.96 specific gravity; 65 per cent of solid soil came out of the pressure pipes. A speed of 8 knots was called for under the contract; the dredge, with full load and basins filled, made an average of 10 knots during a trial trip of several hours, although the coal consumption was minimal, being only at full speed 0.85 kilogram per indicated horsepower hour. If the cost of the dredge and wear and tear are taken into account, the expense of removing 1 cubic meter of mud is hardly 3 pfennigs (¾ cent), while with former dredges the cost was about 12 cents. The dredge is considered a triumph of German shipbuilding.

MR. J. M. GRUBER
GENERAL MANAGER CHICAGO, BURLINGTON & QUINCY.

Mr. Gruber has been in railway service since 1885, beginning with the St. Paul Minneapolis & Manitoba. He was later connected with the Santa Fe system for a number of years as stenographer, clerk, assistant trainmaster at Gainesville, Tex., superintendent of transportation of the Gulf, Colorado & Santa Fe, and chief clerk to general manager of the same road. He was then assistant superintendent of the Eastern of Minnesota for five months, and superintendent of the same road from June, 1895, to July 25, 1896. He was then transferred to the Montana Central as general superintendent, and on March 25, 1897, was appointed assistant general superintendent of the Great Northern. In April, 1903, he resigned to accept the position of general superintendent of the Western district of the Chicago, Rock Island & Pacific at Topeka. He left the latter road on January 28, 1904, and on February 5 of the same year was appointed general superintendent of the Union Pacific. Mr. Gruber left the latter position to become general manager of the Chicago, Burlington & Quincy on February 1, 1905.

THE American Iron and Steel Association publishes the following rail statistics: The production of all kind of rails in the United States in 1904 amounted to 2,284,711 gross tons, against 2,992.447 tons in 1903, a decrease of 707,766 tons or 23.6 per cent. 1904 record, the state of Pennsylvania alone produced 801,637 tons of Bessemer steel rails and 20,451 tons of open hearth rails. The production of Bessemer steel rails in 1904 amounted to 2,137,957 gross tons, aaginst 2,946,-756 tons in 1903, a decrease of 808,799 tons or over 27.4 per cent. The total production of open hearth steel rails in 1904 was 145,883 tons, against 45;054 tons in 1903, 6,029 tons in 1902, 2,093 tons in 1901, and 1,333 tons in 1900. Alabama rolld almost all the open hearth rails that were rolled in 1904, Pennsylvania and Colorado rolling the remainder. Over 116,-000 tons of the open hearth rails rolled in 1904 weighed between 45 and 85 lbs. per yard and over 8,000 tons weighed 85 lbs. or over. The remainder weighed less than 45 lbs. The production of iron rails in 1904 was 871 tons, all rolled in Tennessee and Alabama, and all weighing less than 45 lbs. to the yard. The total production in 1904 of rails weighing under 45 lbs. to the yard amounted to 291,883 tons; of rails weighing 45 pounds and less than 85 pounds, 1,320,677 tons, and of rails weighing 85 pounds and over, 672,151 tons. The production of rails weighing under 45 pounds to the yard shows an increase of 70,621 tons in 1904, as compared with 1903, but the production of rails weighing 45 pounds and less than 85 pounds shows a decrease of 282,411 tons as compared with 1903. The great falling off in rails in 1904 as compared with 1903 was, however, in sections weighing 85 pounds and over, in which the decrease amounted to 495,976 tons.

New Angus Shops, Canadian Pacific Railway

THE Canadian Pacific Railway recently put into operation one of the largest and most complete locomotive and car shops. This road has a mileage of 8,183 miles and owns 840 locomotives and 28,655 cars. The road is divided into the eastern and western divisions, each of which has its own separate management.

The locomotive shop was designed to handle the heavy repairs of half of 450 locomotives on the eastern division. The heavy repairs of the western division will be handled at the new shop, nearly completed at Winnipeg. At present they are turning out one new locomotive per week and about 35 repairs per month.

The plant has a local telephone system connecting all the foremen's offices. This system has a capacity of one hundred 'phones.

The shop buildings are arranged on either side of a center passage or midway over which is located a 10-ton crane running on structural steel supports. The tracks from the different buildings extend into or across the midway, and all materials in transit between the shops or storehouse are handled by this crane.

The general office building which contains the offices of the motive power and car departments, including the test department, and general storekeeper, is located in the center nearly opposite the end of the midway to the southeast of the shop buildings. Starting from this end of midway, the locomotive shop building, which includes the erecting, machine, boiler and tank shop, is the first building to the left. Almost directly opposite this is the general storehouse, whose platform extends far enough into the midway to allow the crane to take material from it. The next building on the right side is the blacksmith shop. Opposite the blacksmith and next to the locomotive shop is an iron foundry, and following on the left is the pattern shop, behind which is a fireproof building for pattern storage. Next comes the car machine shop, then the truck shop, and the last building on the left side is the freight car shop. Opposite the freight car shop is the planing mill. Between the planing mill and the blacksmith shop, located back from the midway, is the power house. All these buildings, with the exception of the power house, receive and exchange material from the midway crane. Directly back of the truck shop is the wheel foundry and core sand shed. A frog shop is located back of the pattern store house and an oil house room back of the grey iron foundry. Another crane travels at right angles to the midway crane along side of the grey iron foundry. This crane handles the supplies of the foundry as well as elevating the material to the charging platform. The two passenger car shops with a 75 ft. transfer table between are back of the blacksmith shop. The cabinet shop, including the hardwood store room and upholstery, is back of the power house, alongside of the passenger car shop. The dry kiln is located back of the planing mill and the cabinet shop.

The location of buildings and arrangement of tracks is clearly shown in the general layout. From this it is seen that loaded cars can be run into or alongside of all the buildings or under the midway crane.

The walls, which are constructed of brick laid in cement mortar, rest on a foundation of concrete three feet high. This extends a short distance below the ground. Below the concrete is rubble masonry, and this rests on dry rock wall carried down to rock foundation.

The heating is by means of the Sturtevant system of hot air blast. The hot air pipes are carried overhead, with downward outlets in all cases, except on the erecting side of the locomotive shops, where ducts are under the floor. with uptakes every four bays.

There is a tunnel leading from the power house across the midway and from there parallel to the midway connecting all the buildings. This is used for steam, air and water pipes.

Besides the midway crane and foundry crane, there is

FIG. 1—VIEW DOWN THE MIDWAY, CANADIAN PACIFIC SHOPS.

FIG. 2—VIEW IN THE ERECTING SHOP, CANADIAN PACIFIC SHOPS SHOWING STRUCTURAL WORK.

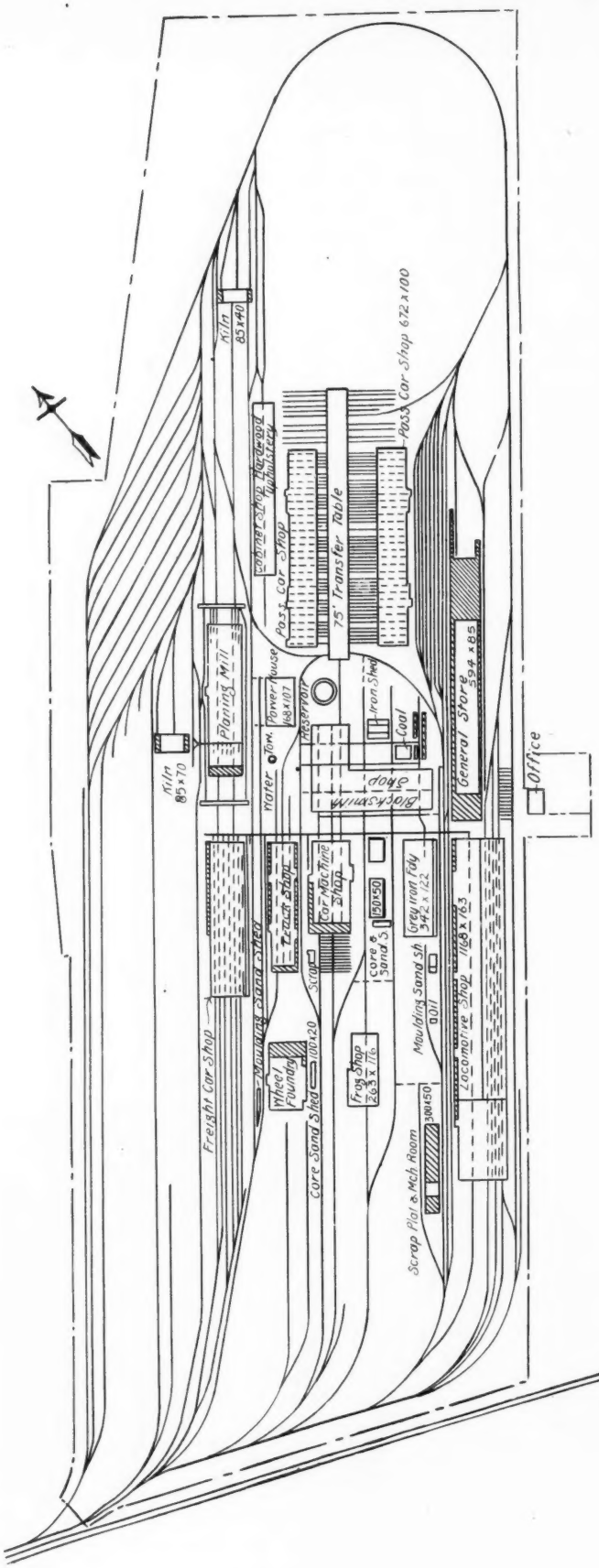


FIG. 3—GENERAL LAY-OUT, CANADIAN PACIFIC SHOPS.

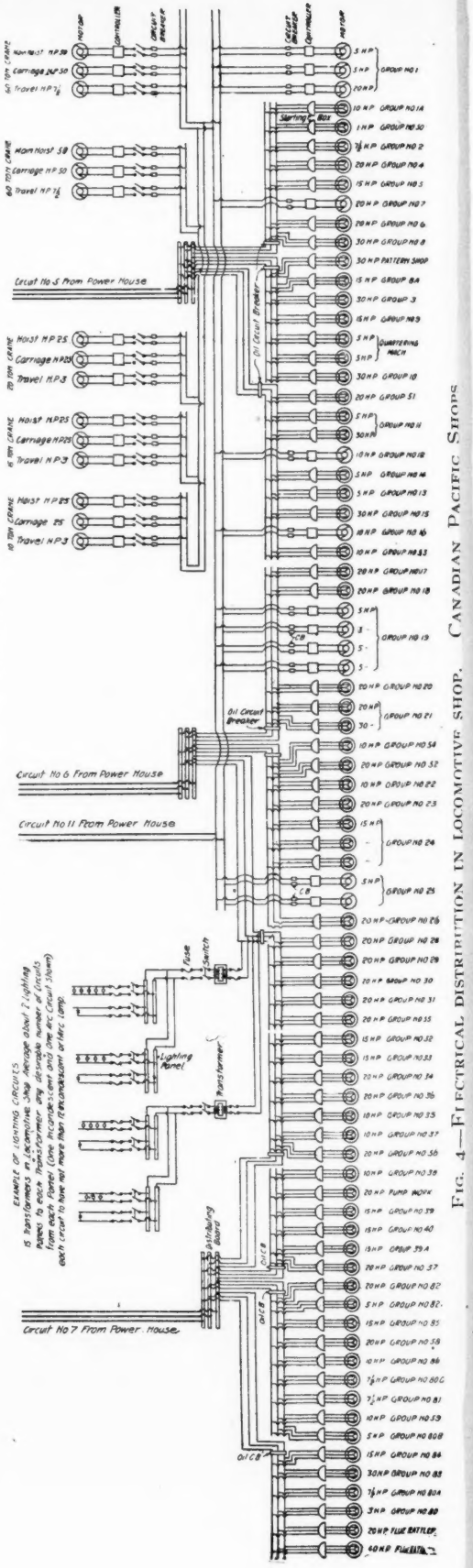

Circuit No 5 From Power House
Circuit No 6 From Power House
Circuit No 11 From Power House
Circuit No 7 From Power House
Oil Circuit Breaker
Starting Box
Lighting Panel
Transformer
Distributing Board
EXAMPLE OF LIGHTING CIRCUITS
15 Transformers in Locomotive Shop Average about 7 Lighting Panels to each Transformer any desirable number of Circuits from each Panel (One incandescent and one arc Circuit shown) each Circuit to have not more than 10 incandescent or arc Lamps

FIG. 4—ELECTRICAL DISTRIBUTION IN LOCOMOTIVE SHOP, CANADIAN PACIFIC SHOPS.

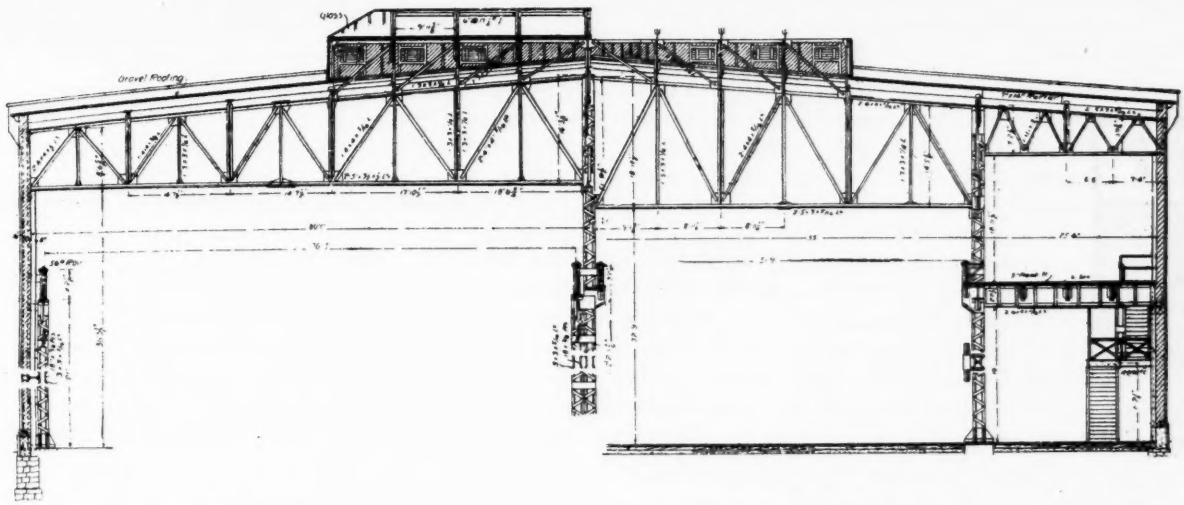


FIG. 5—CROSS-SECTION OF LOCOMOTIVE SHOP, CANADIAN PACIFIC SHOPS.

a 30 ft. radius rubber-neck crane, built by the Browning Engine Co., of Cleveland,O. , for handling material in the yards. There is also an industrial railway in and about the buildings. This has a 2 ft. gage track inside of the regular track. In some places this is double track and very narrow cars are used so as to be able to pass one another.

LOCOMOTIVE AND MACHINE SHOP.

This is the largest building. It measures 162 ft. 8 ins. x 1,167 ft. 4 ins. outside. It is arranged in three bays, running longitudinally. Half of the building, forming one bay, is given up to the erecting, tank and part of the boiler shop. The next bay, comprising about two-thirds of the other half of the building, is for heavy machine tools and boiler shop machinery, and the third bay, over which there is a gallery, is for small machine tools. The gallery is also used for small machines and tool work.

Over the erecting shop, which has three parallel erecting pits and two standard gage supply tracks, are two 60 ton cranes, each with a 10 ton auxiliary hoist, and on the same runway is a 20-ton crane, which is intended principally for boiler shop work. On the machine side there is one 20 ton and one 10 ton crane over the heavier machine tools, and numerous jib cranes extending from the building columns. These in most cases carry an air hoist or in a few cases electric driven chain hoists. Over the boiler shop is a hydraulic crane, which serves the large riveter.

The main roof trusses, which are steel, are carried by a steel frame work. The roof is of 3-inch planks laid on heavy wooden rafters and covered with gravel roofing and galvanizzed iron flashing at the connection with the monitors. These transverse monitors are 12 ft. wide and 72 ft. long and have ventilating doors on the sides and two rotary ventilators on top. The roofs of the monitors are of glass. The walls are provided with two rows of large windows.

All the machines are electrically driven, in most cases in group form from a counter-shaft, but there are also quite a large number of individually driven machines, to some of which the motors are directly connected, and in others the motor rests either on the floor or column and is belted to a short shaft. Alternating current, three-phase induction motors are used principally. But in cases where variable-speed is required, direct-current motors have been installed. These are usually direct-connected to the machine.

(To be continued)

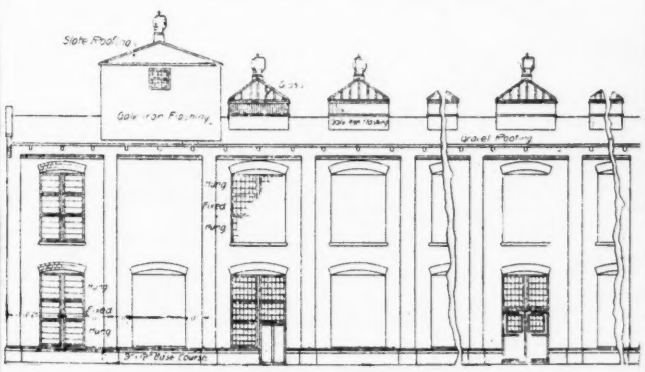


FIG. 6—ELEVATION OF LOCOMOTIVE SHOP, CANADIAN PACIFIC SHOPS.

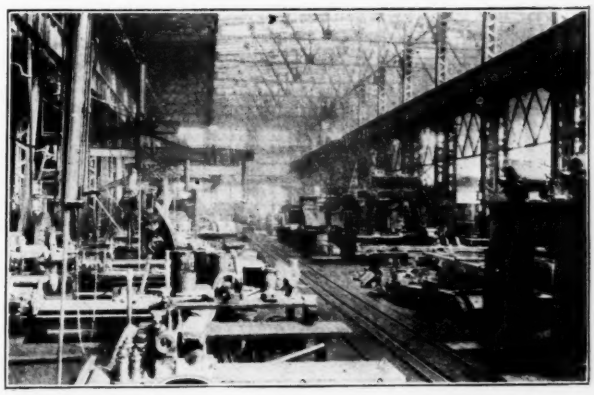


FIG. 7—VIEW IN MACHINE SHOP, CANADIAN PACIFIC SHOPS.

FIG. 4—ELECTRICAL DISTRIBUTION IN LOCOMOTIVE SHOP, CANADIAN PACIFIC SHOPS.

Sand Houses and Appliances

HE Erie Railroad uses two different kinds of sand driers and houses. Fig. 1 shows their steam drier. This consists of three hoppers joined in one continuous bin. The inside of the hopper is filled with steam pipes. As the wet sand, which is dumped or shoveled into the top, works its way downward it comes in contact with the hot steam pipes which dries it, and slowly drops into the hopper beneath. From the hopper it drops into the funnel, which is shown in detail in Fig. 7. The bottom of this funnel is connected to a pipe which leads into an air pipe. When air is passed through this pipe it takes the sand like an injector takes water and deposits it in the sand bin in the tower.

The other sand drier in use consists of a stove, as shown in Fig. 3. In this the sand is shoveled in the hood around the stove. As the sand dries it drops out through the holes in the iron ring at the bottom. This stove is usually placed over a funnel-shaped receptacle. The receptacle has a sieve in it to catch any gravel that may be in the sand. Below the receptacle and joined to it is a reservoir, the opening to which is controlled by a handle near the stove. This arrangement works as fol-

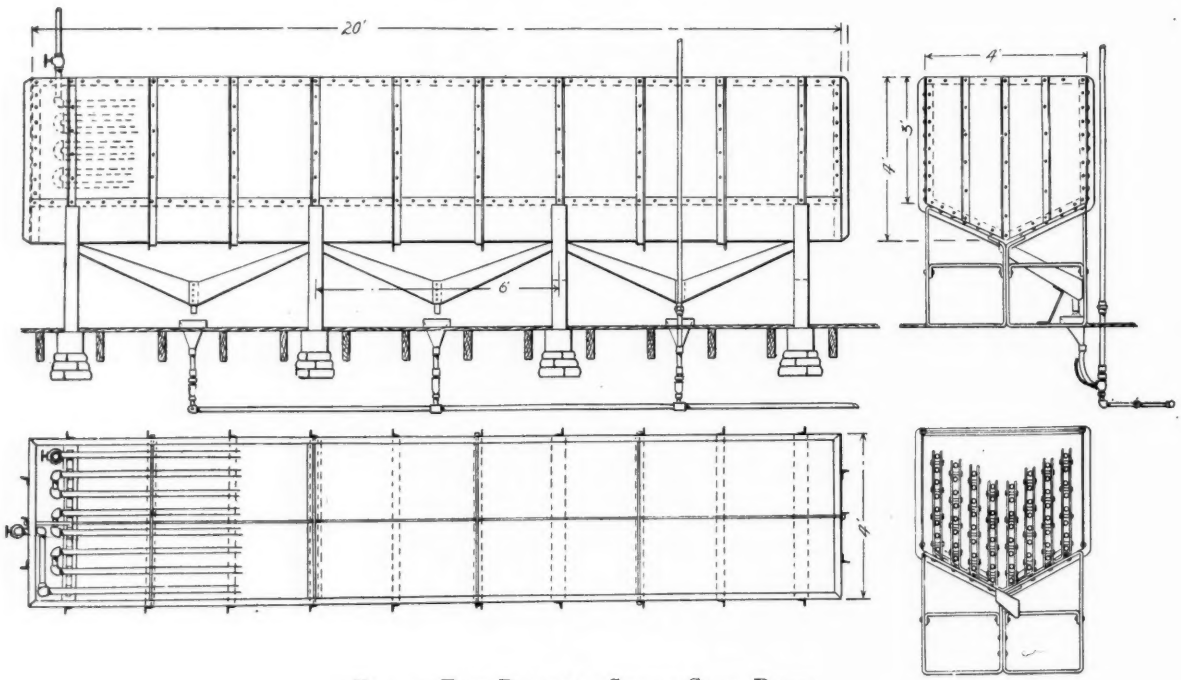


FIG. 1—ERIE RAILROAD STEAM SAND DRIER.

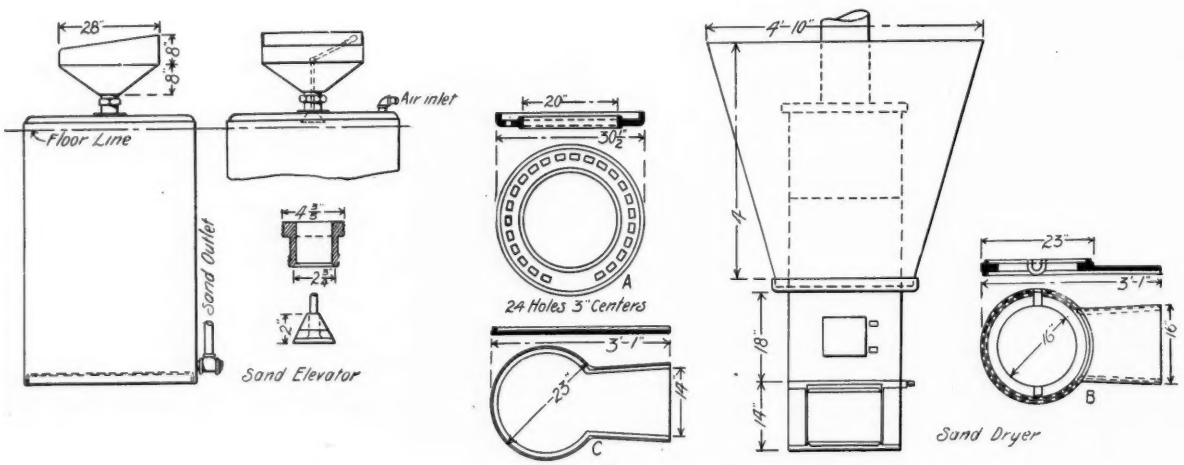


FIG. 3—ERIE RAILROAD STOVE SAND DRIER AND ELEVAT ING DRUM.

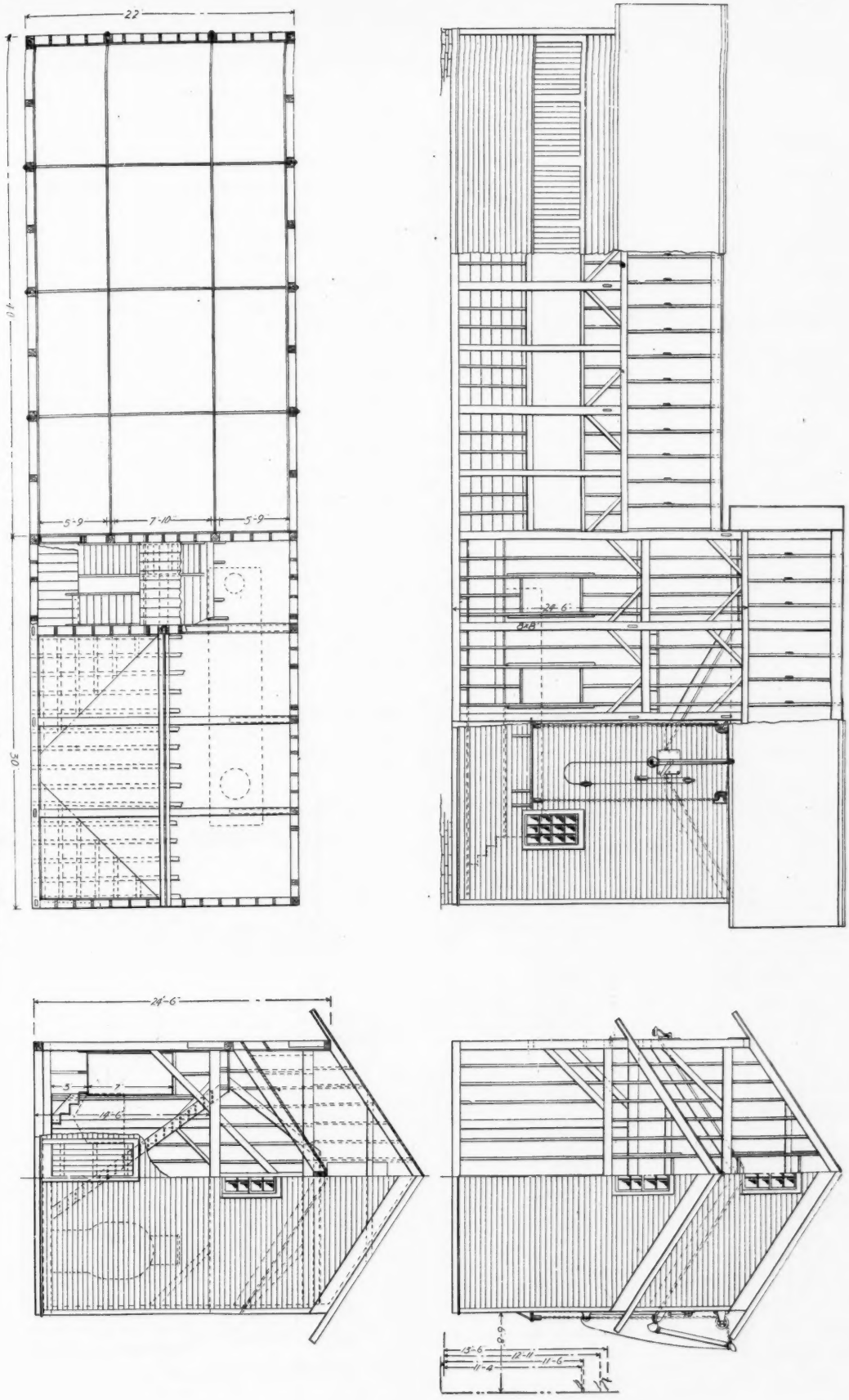


FIG. 2—ERIE RAILROAD ARRANGEMENT OF SAND HOUSE.

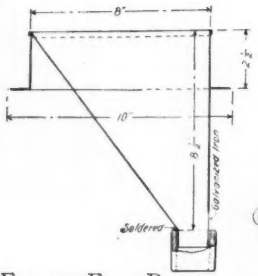


FIG. 7—ERIE RAILROAD HOPPER FOR SAND DRIER.

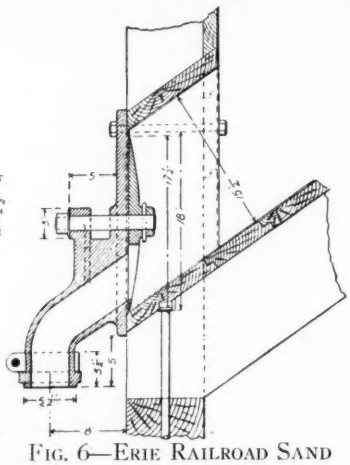


FIG. 6—ERIE RAILROAD SAND VALVE IN STORAGE BIN.

lows: Sand is allowed to fill the reservoir by gravity; then the valve at the top is closed and the air pressure turned on. This pressure forces the sand through the pipe at the bottom and elevates it to the sand bin.

The two kinds of sand houses in use are shown in Figs. 2 and 4. In Fig. 2 the wet sand is stored at the left, where it is easily shoveled from cars through the openings at the side. From this it is moved in wheelbarrows to the drying room alongside. The drying room may have either of the driers described above. Fig. 2 shows the steam drier and boiler. The storage bin is directly above the drying room.

Fig. 4 shows a narrow sand tower for use when there is litte room for spreading the tracks. In this case the drying and wet sand rooms may be placed at any convenient point.

Fig. 6 shows the sand valve in the storage bin. This consists of a circular cast iron plate with a hole at one side and fastened in the middle by a bolt. This circular disk is revolved to open the valve.

We are indebted to Mr. G. W. Wilden, mechanical superintendent, for the above information.

The Cincinnati Northern uses two kinds of sand elevators. Figs. 8, 9 and 10 show one form. In this sand is stored in a bin as shown in Fig. 9, from which it is transferred into a steam drier as shown in Fig. 10. This has two sets of netting at the bottom to remove pebbles, etc. After the sand gets through the second netting it drops into a bin which slopes under a bucket elevator. The elevator drops the sand into the storage bin directly above the drier.

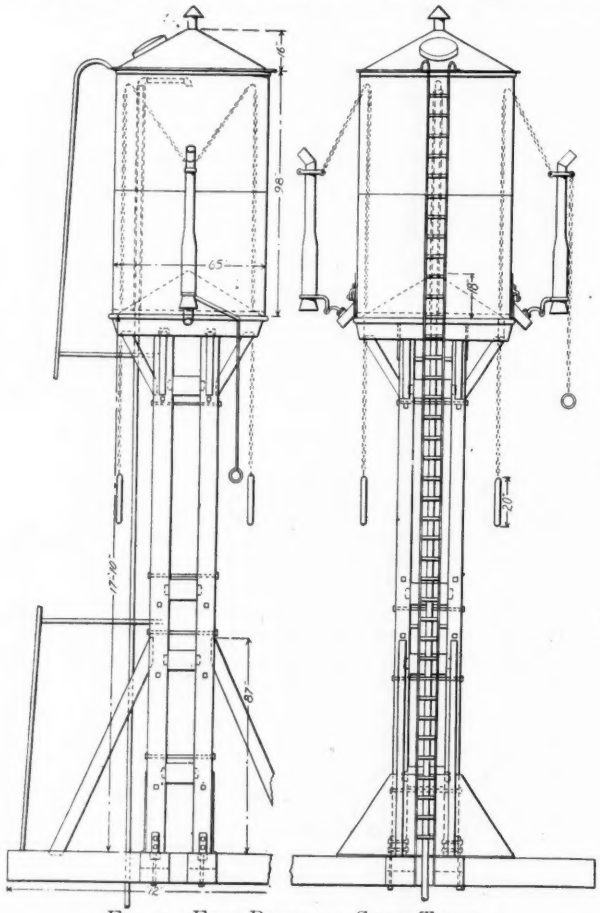


FIG. 4—ERIE RAILROAD SAND TOWER.

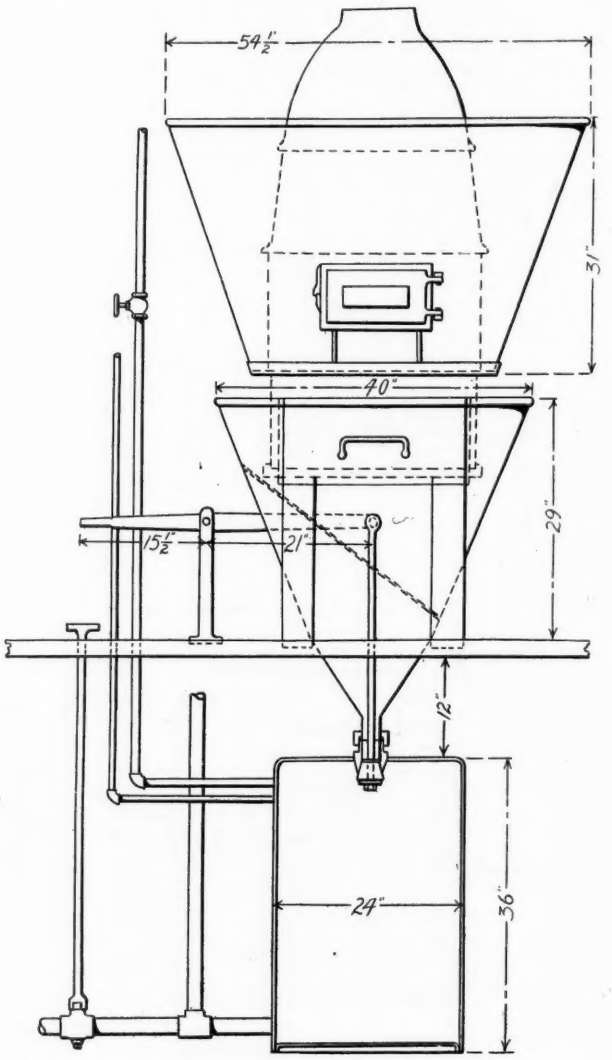


FIG. 5—ERIE RAILROAD SAND STOVE AND ELEVATING DRUM.

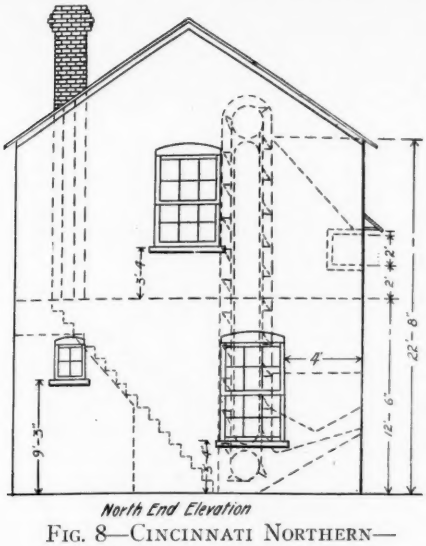


FIG. 8—CINCINNATI NORTHERN—ELEVATION OF SAND HOUSE.

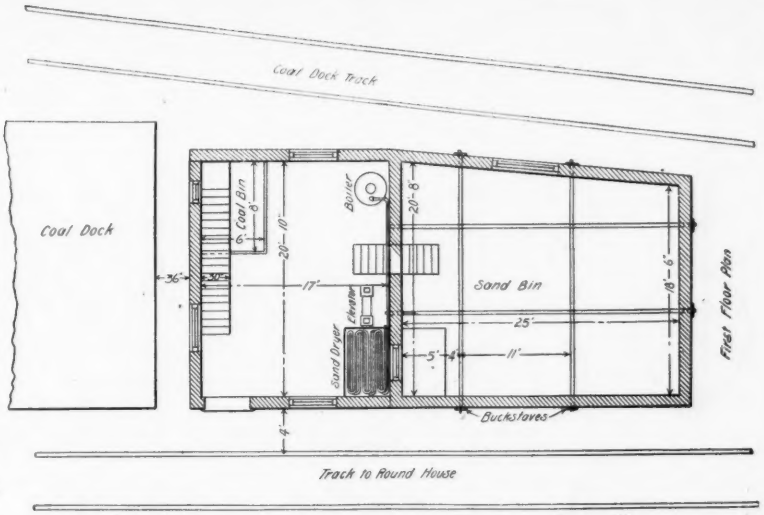


FIG. 9—CINCINNATI NORTHERN—PLAN OF SAND HOUSE.

The other form of elevator is shown in Fig. 11. This device is automatic in operation and works as follows:

The sand is dried in any suitable drier and delivered to drum by gravity. The hoist consists of a drum and a system of weights and levers. The drum shown in Fig. 11 will hold 800 lbs. of dry sand, and the weights are adjusted to balance the drum when half full of sand, so when the drum is full it is 400 lbs. heavier than the weights, and when empty the weights are 400 lbs. heavier than the drum. A 2-in. pipe extends straight up from bottom of drum to top of storage bin in sand house tower, securely fastened to this pipe, and 1½ inches below the casting on top of drum is a half rubber ball which forms an air-tight joint when drum settles down on it, the pipe being securely fastened at the top with a spring rigging not shown in cut. The nipple on bottom of drier is 4½ inches inside, which a 1-in. space allowed the 2-in. pipe loose fit on nipple, so the drum is free to move up and down. A ½-in. nipple is screwed into top of drum, to which is fastened an air hose, the valve of which is connected to lever by rod. On each of the levers is a weight adjuster, which is so adjusted with a spring and screw that the drum is held in extreme position, either up or for sand to pass into drum. The casting on drum is a down, until it is either full or empty.

In operation the drum is held in its uppermost position by the weights, which give maximum opening for sand, and also holds the air valve closed. When the drum is

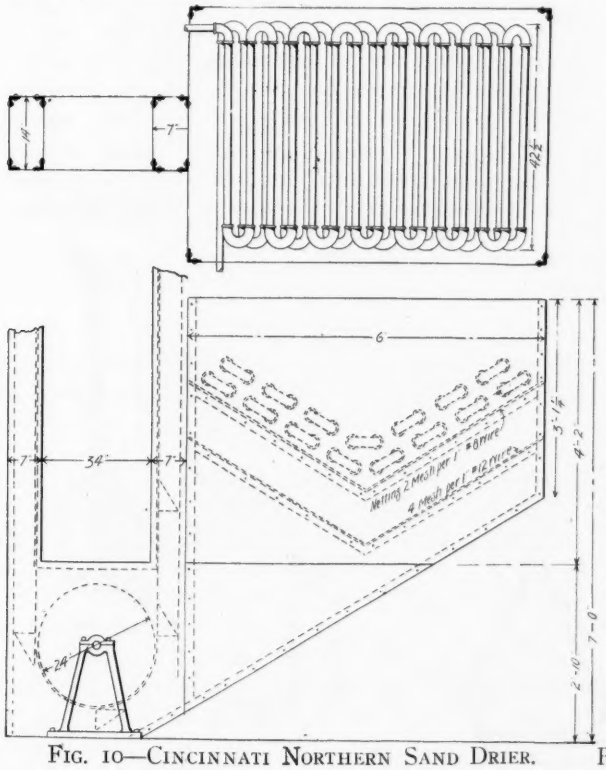


FIG. 10—CINCINNATI NORTHERN SAND DRIER.

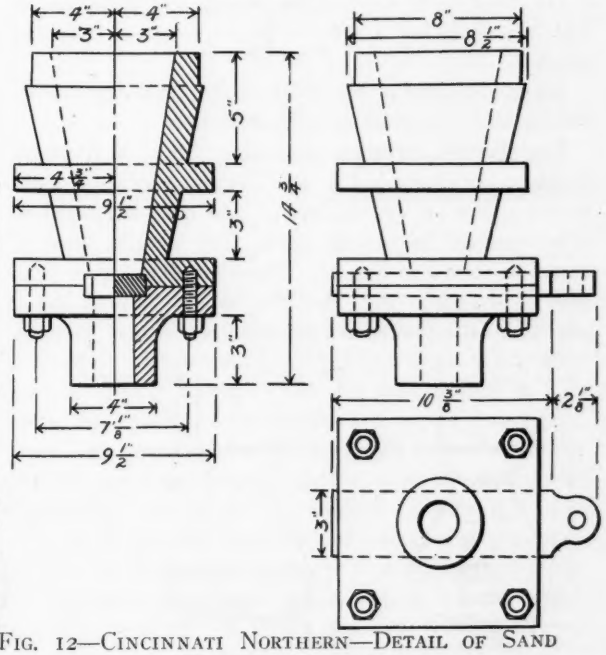


FIG. 12—CINCINNATI NORTHERN—DETAIL OF SAND VALVE IN TOWER.

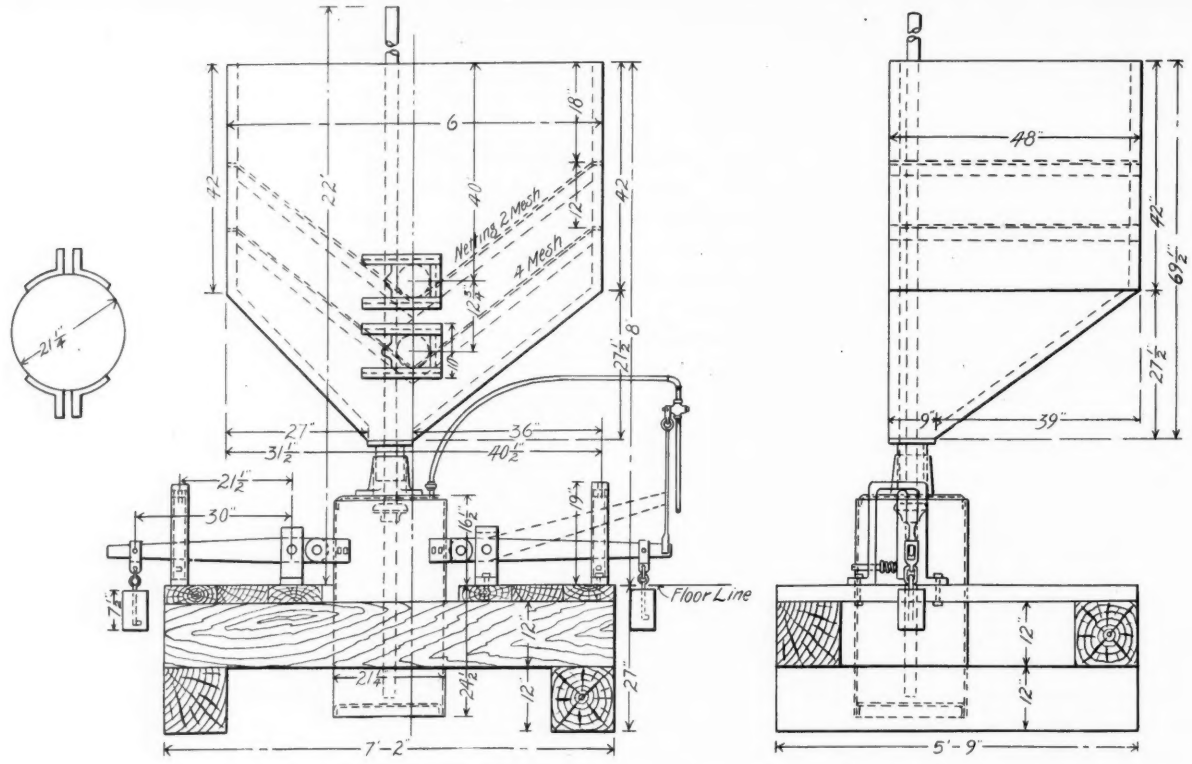


FIG. 11—CINCINNATI NORTHERN—AUTOMATIC SAND ELEVATOR.

full it drops down on the rubber ball, making an air-tight joint at sand inlet, and at the same time the outer end of lever moving upward opens the air valve, letting the air into top of drum, which forces the sand up through the 2-in. pipe into storage bin. When the drum is empty the weights pull the levers down, raising the drum, opening sand inlet and closing air valve, thus making it practically automatic.

The sand valve used in the storage bin is shown in Fig. 12. This has a slide which pulls out to open the valve.

We are indebted to Mr. A. H. Watts, master mechanic, for the above illustrations and description.

The plan and elevation of the Lake Shore & Michigan Southern are shown in Fig. 13. The wet sand storage bin is not shown in the engravings, but may be placed at either end of the drying room. The sand is dried in stoves as shown in Fig. 16. These are placed over hoppers as shown in Fig. 15. The hoppers have a screen near the bottom to remove any pebbles that may be in the sand. When the sand falls through the screen it goes into the opening as shown in Fig. 14.

The elevating device is automatic. The valve at the top of the reservoir consists of a rubber ball fastened to a rod which connects to a piston in a cylinder above. When the reservoir is full of sand the operator turns on the air in pipe marked to operating lever. This admits the pressure on the bottom side of the piston and raises it, closing the valve in the reservoir. When the valve is closed the piston uncovers the opening in the cylinder leading down to the reservoir. The sand is then forced through the 2-in. W. I. pipe to the storage bin above.

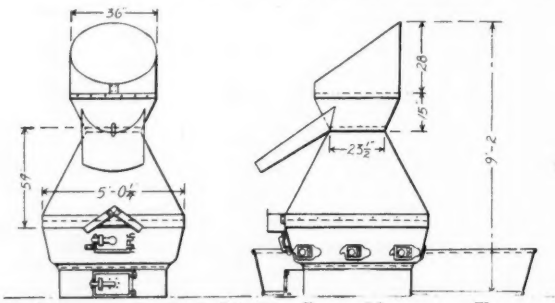


FIG. 17—L. S. & M. S.—SAND VALVE IN TOWER.

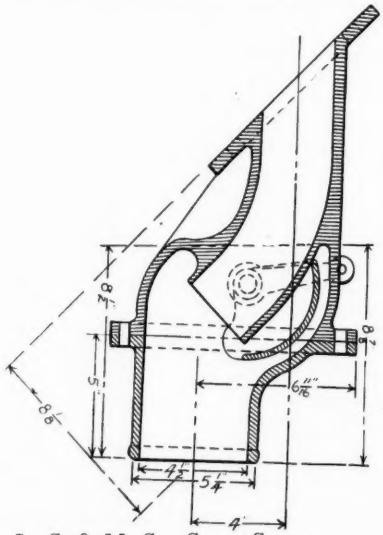


FIG. 16—L. S. & M. S.—SAND STOVE.

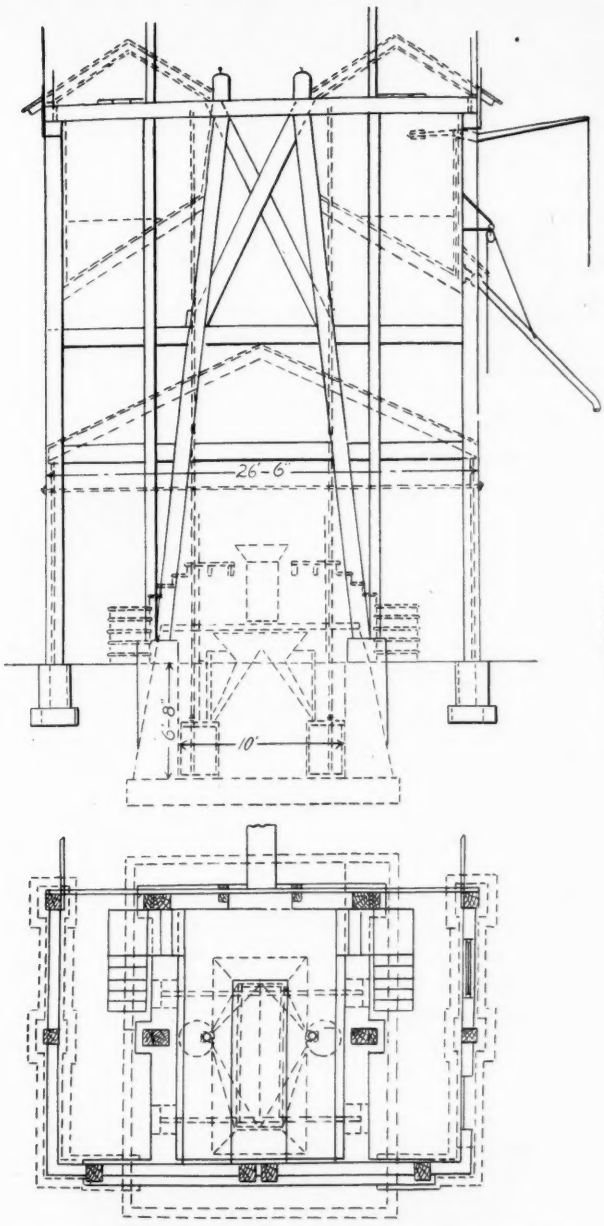


FIG. 13—L. S. & M. S. PLAN AND ELEVATION OF SAND HOUSE.

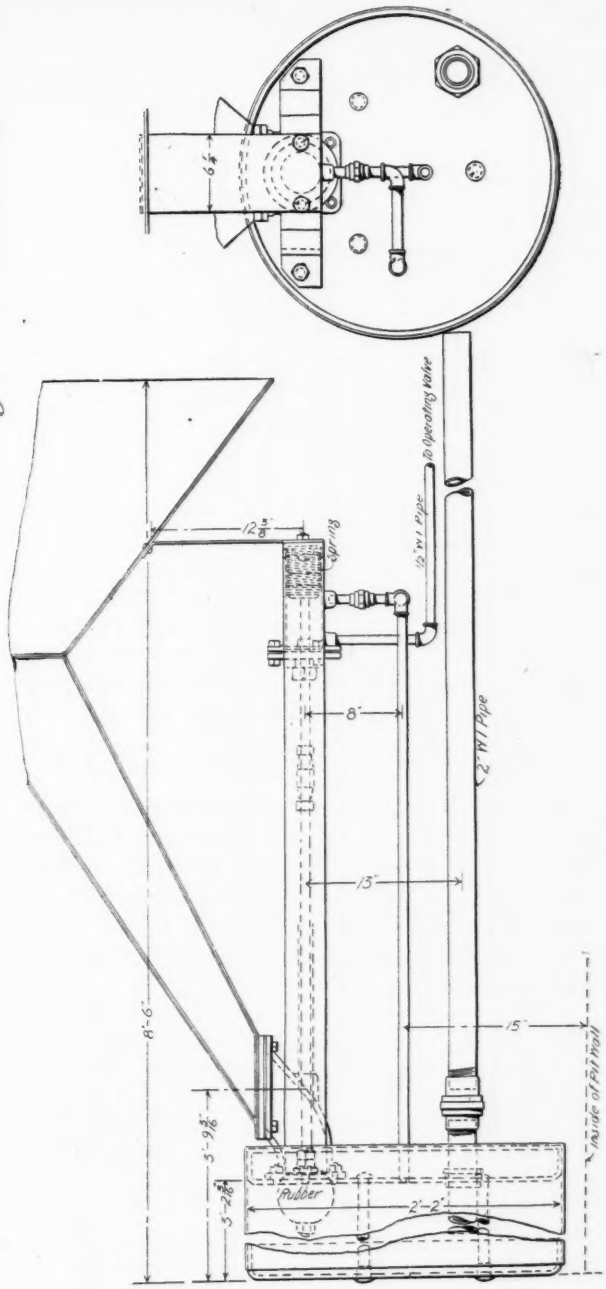


FIG. 14—L. S. & M. S. ELEVATING DEVICE.

When the operating valve is closed the pressure beneath the piston is released and a spring forces the piston down, opening the valve for admitting more sand to the reservoir.

The sand valve for the storage bin is shown in Fig. 17. It is controlled by a rope from below. It opens by removing the bucket-shaped casting from beneath the opening in the outlet.

We are indebted to Messrs. H. F. Ball and R. B. Kendig for the above illustrations.

The sand house arrangement of the Chicago & Northwestern is shown in Figs. 18, 19 and 20. Fig. 18 shows the plan. In this sand is brought into the wet sand bins on tracks as shown. These tracks extend up to the sand stoves, of which there are three. The sand when dried in the stoves is allowed to drop on the floor; it is then shoveled on screens to remove the pebbles, etc. This arrangement is shown in elevation at the right of the floor plan and also in Fig. 20. The fine sand collects in bins below the screen and the pebbles fall on the floor again. From this temporary bin the sand goes to a reservoir by gravity, and from there by means of an air injector to the storage bins above. This injector consists of a large pipe tapping into the reservoir and a smaller air pipe projecting into the end of the larger pipe. When air is admitted under pressure it will create a vacuum, which draws the sand into the larger pipe until it comes in contact with the air jet, when it is forced to the bin above.

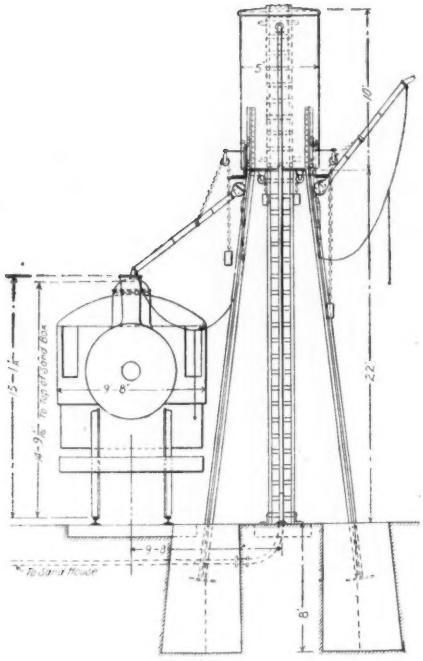


FIG. 19—C. & N. W. SAND TOWER.

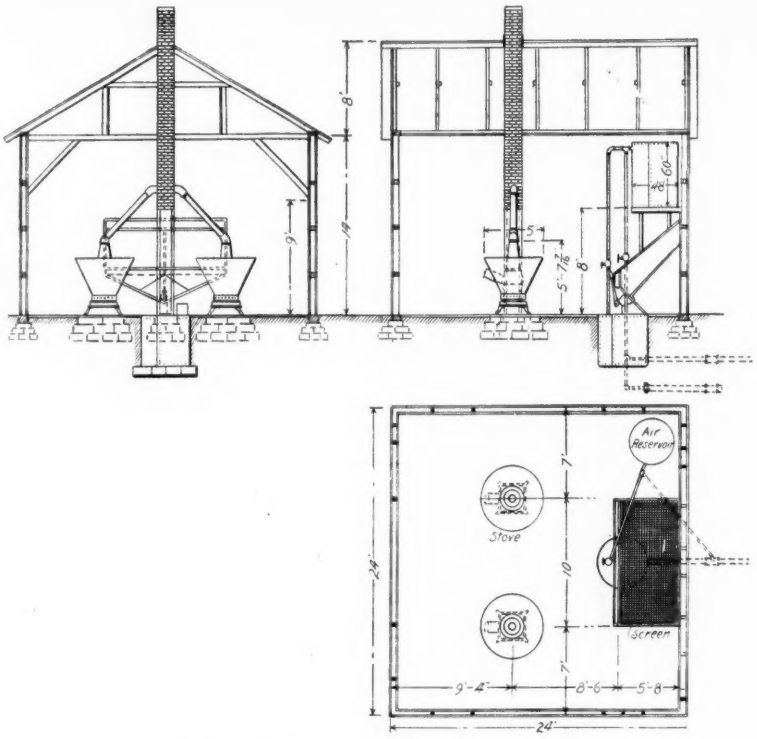


FIG. 20—C. & N. W.—PLAN AND ELEVATION OF SAND HOUSE.

The sand tower, which is a separate structure, is shown in Fig. 19. This is simply a storage bin set on old rails. This form of bin can be used where the tracks are fairly close together and thus save space in a place where it is generally needed badly.

We are indebted to Mr. H. T. Bentley for the above illustrations.

Figures 21 and 22 show one of the types of the Clark "Perfect" sand driers, which are manufactured by the Parkhurst & Wilkinson Company, of Chicago. This sand drier received the premium as the best sand drier at the National Exposition of Railway Appliances, and it is in extensive use not only throughout the United States but in Canada, Europe and South America. These driers are built in the fashion of an hour glass, the wet sand being shoveled against the stove and as it dries it is allowed to run out through apertures in the perforated ring which surrounds the bottom of the hopper. The amount of sand that will pass through this machine in a given time is variable and depends largely upon the conditions under which it is used; that is to say, how wet the sand is when

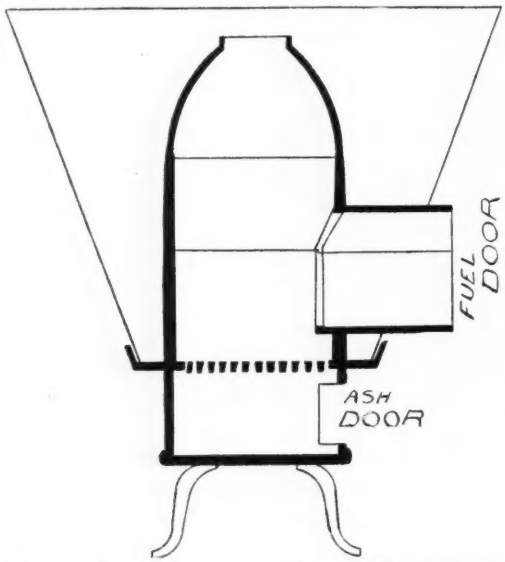


FIG. 21—CROSS SECTION OF CLARK'S SAND DRIER.

FIG. 22—EXTERIOR VIEW OF CLARK'S SAND DRIER.

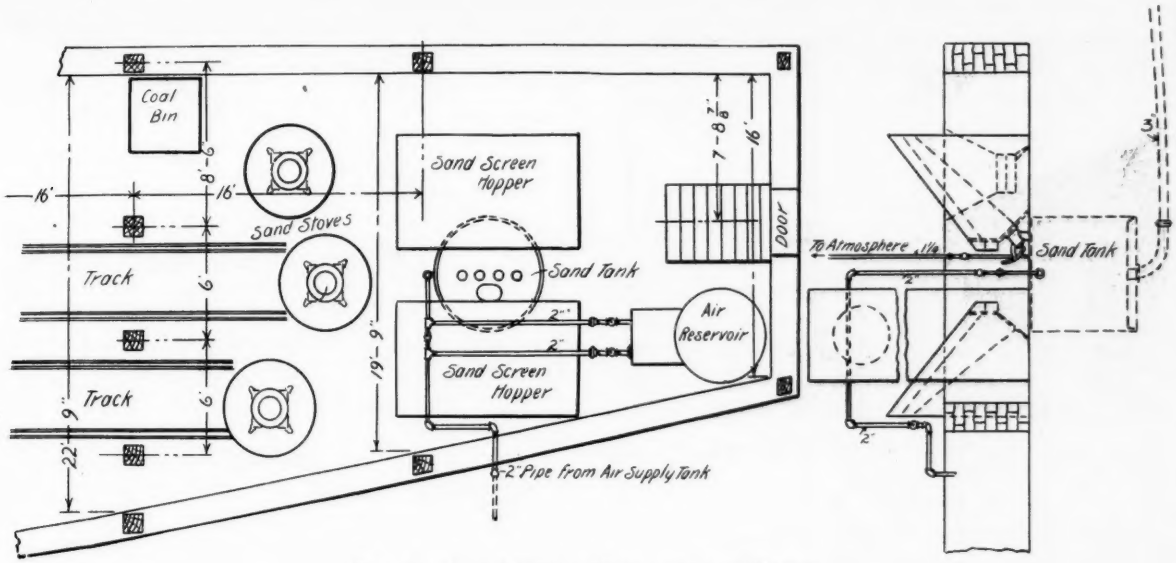


FIG. 18—C. & N. W.—PLAN OF SAND HOUSE.

it is put in the hopper and also the intensity of the fire maintained in the stove. The furnace is arranged to use any kind of solid fuel such as hard or soft coal or wood. These driers are for use with clear sand only, as earth or clay will merely bake and will not discharge itself from the machine. These driers are claimed to be the best ever put upon the market for preparing sand for use on locomotives and street cars.

New Signal Appliance

THE Boston and Main Messenger, in its issue of April 1, published the following descriptive of an interchangeable block and train order device:

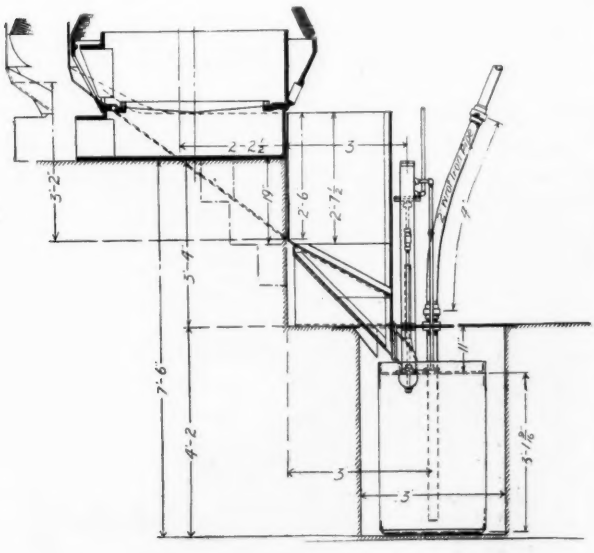


FIG. 15—L. S. & M. S.—SAND HOPPER AND ELEVATING DRUM.

An important improvement in connection with the telegraphic operations of trains has recently been perfected by Superintendent of Signals John V. Young, of the Boston & Maine Railroad, and a photographic illustration of the workings is herewith given.

Through the application of Mr. Young's invention the standard train order signal is convertible into a telegraph block signal and by the very ingenious appliance, known as a pendulum pawl, it is impossible for the signal lever to latch in the "caution" position while moving from "safety" to "danger."

The act of latching the signal lever in the "caution" position must be a deliberate act on the part of the operator.

The new device is applied to the regulation signal, the lights or arms of which are about 28 or 30 feet above the ground. The signal lights, as every Boston & Maine employee knows, are red for "danger," green for "caution" and white for "clear." The arms or blades used for day signals are painted red with a white transverse stripe on the face or running side and white with a black transverse stripe on the back of the blade.

The position of the signal arm denotes to the engineer of the approaching train how he shall govern himself. If the arm is in a vertical position by day or shows a white light by night, it means that there is no train in the "block" ahead of him. If it is placed at an angle of 45 degrees or shows a green light by night, it means that he must use caution and go slow, as the preceding train has not passed out of the block ahead. When the arm is in a horizontal position or shows a red light by night it spells "danger" and the train must come to a stop until orders are received to go ahead again.

The usefulness of the new invention lies not only in the fact that the signal can be alternately used for block and train-order purposes, but that through the

FIG. 1—SHOWING ORDERS FOR EAST AND WEST BOUND TRAINS.

application of the pendulum pawl it is a physical impossibility for the operator working at his position within the station building, to set the signal at "caution" until it has first registered "danger."

The instant a lever is released, after a train has passed—and it must be held down by the operator while at clear—it rises by its own force to the topmost of its three notches or latches. It cannot stop at the middle or "caution" latch, because in rising it carries the pawl with it and the latter neatly and effectually prevents the lever from stopping there.

It simply has to go to the top or "danger" notch and remain there until the operator has pulled it down again. The pawl is so peculiarly balanced and constructed that it does not prevent the latching on the downward pull.

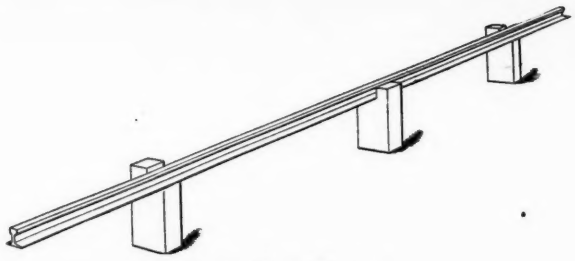
It is in requiring this conscious effort on the part of the operator that the chief value of the invention lies. There can be no inadvertent setting of a signal at "caution" when the operator really intended to set it at "danger" under this system.

The rule of the Boston & Maine Railroad relative to the operation of the telegraph block signal system reads as follows: "When any train enters the block the danger signal must be displayed for five minutes, except that in case of a freight train it must be displayed for ten minutes, when, if a train is ready to follow, and the preceding train has not passed the next block station it will be allowed to pass under a green (caution) signal and trains must run with caution, expecting to find other trains ahead in the same block."

The improved system is in successful operation on different parts of the Boston & Maine road, the signal shown in accompanying illustration being the one at Williamstown, Mass., on the Fitchburg Division.

The signal department are now erecting 80 of these train-order signals that can be converted into a telegraph block signal by about five minutes' work at each place.

Some 75 of the new electric semaphores, which are automatic in their action and a great improvement on all former signals, have also been installed in different parts of the Boston & Maine system and are giving great satisfaction. The blades of these have only two positions—horizontal for "danger" and a position of 60 degrees for "clear."



EXTRA RAIL HOLDER.

Superintendent Young has also invented a very useful "range-finder,' not for the purpose of detecting the position of the enemy, but for correcting the position of signal lanterns that, from the warping of the wooden posts or other causes, have got slightly out of "true."

These lanterns are supposed to have the center of their lenses in a certain exact position, with reference to the vision of the engineer of the approaching train, and a deflection of the fractional part of an inch may mean a great difference in the quality of the light a couple of hundred feet or yards away.

By the use of this new "range-finder," which includes a small brass telescope and appliances for adjusting the whole affair to the signal post, the slightest error in the position of a lantern can be detected and the matter set right.

This may seem a very small and unimportant thing to a layman, but it goes to show how the railroad managers and experts of the country are racking their brains day and night to discover some additional way of safeguarding public travel, or rendering that travel more expeditious.

Extra Rail Holder

In its column "Picked up on the Road" of the March 3 issue of the Railroad Gazette the following description and cut was given: "The accompanying

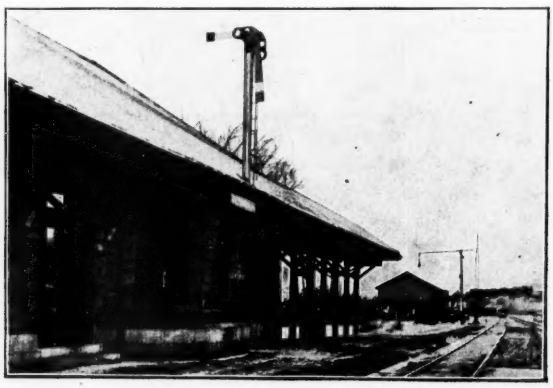


FIG. 2—SHOWING ORDERS FOR EAST BOUND TRAINS ONLY.

sketch shows the form of extra rail-holder that is used on the Vandalia Line. It is formed of three notched ports set in line with the middle one facing in the opposite direction from the other two. By this arrangement the rail is prevented from falling to the ground and at the same time it can be easily picked up for use or another dropped down into place. There is nothing very remarkable about it, other than that it is a handy arrangement for the purpose for which it is intended.

The Reconstruction of the Baltimore & Ohio Railroad Bridge Over the Ohio River, at Benwood, West Virginia

Presented by J. E. Greiner, M. Am. Soc. C. E., April 19, 1905.

The Old Bridge.

THE original bridge at this place was built under the general authority given by the Act of Congress approved July 14, 1862. This act provided that bridges built over the Ohio river above the mouth of the Big Sandy should not have a less elevation than 90 feet above low-water mark in the channel, nor a less span than 300 feet over the main channel the next adjoining span to be not less than 220 feet.

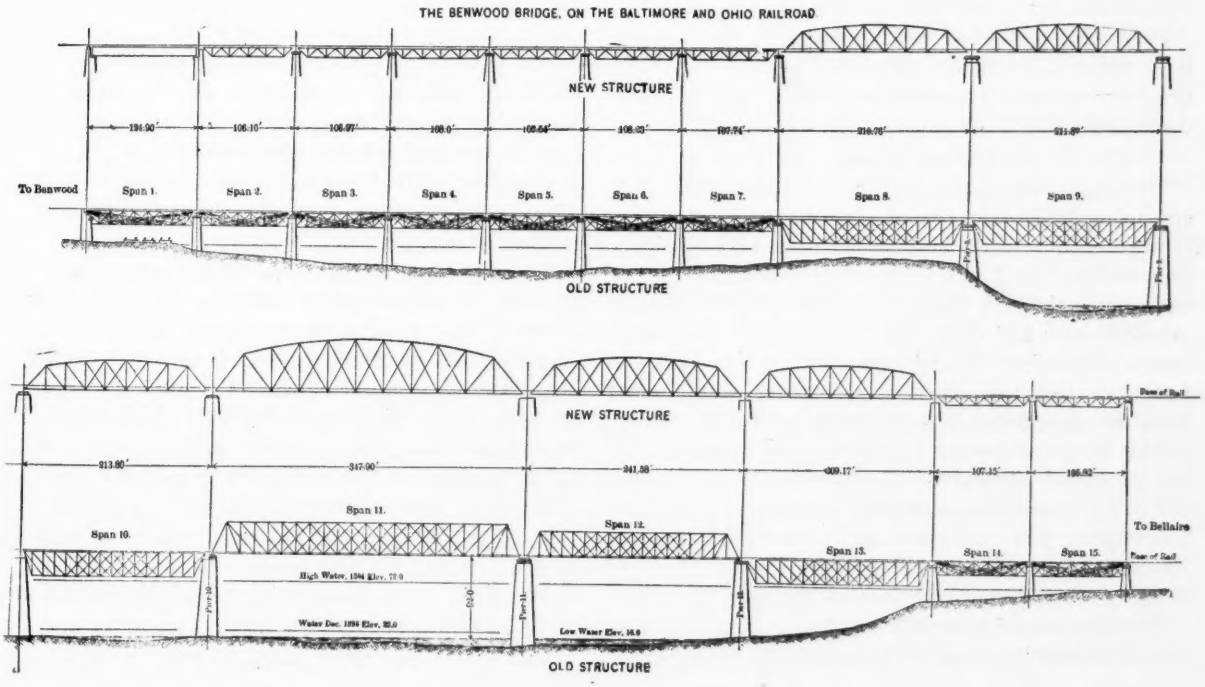
The bridge was composed of 9 Bollman deck spans, 4 deck spans and 2 through spans of Linville and Piper type, as shown on Plate XXIV, and, in addition thereto, there was an approach on the Ohio side consisting of 43 semi-circular stone arches, with 28 feet clear span and a total length of approach of 1,490 feet. The length of the iron bridge, from center to center of abutments, is 1,435 feet 6 inches, and the total length of the entire bridge, including approach, from end to end of masonry, is 3,916 feet 10 inches.

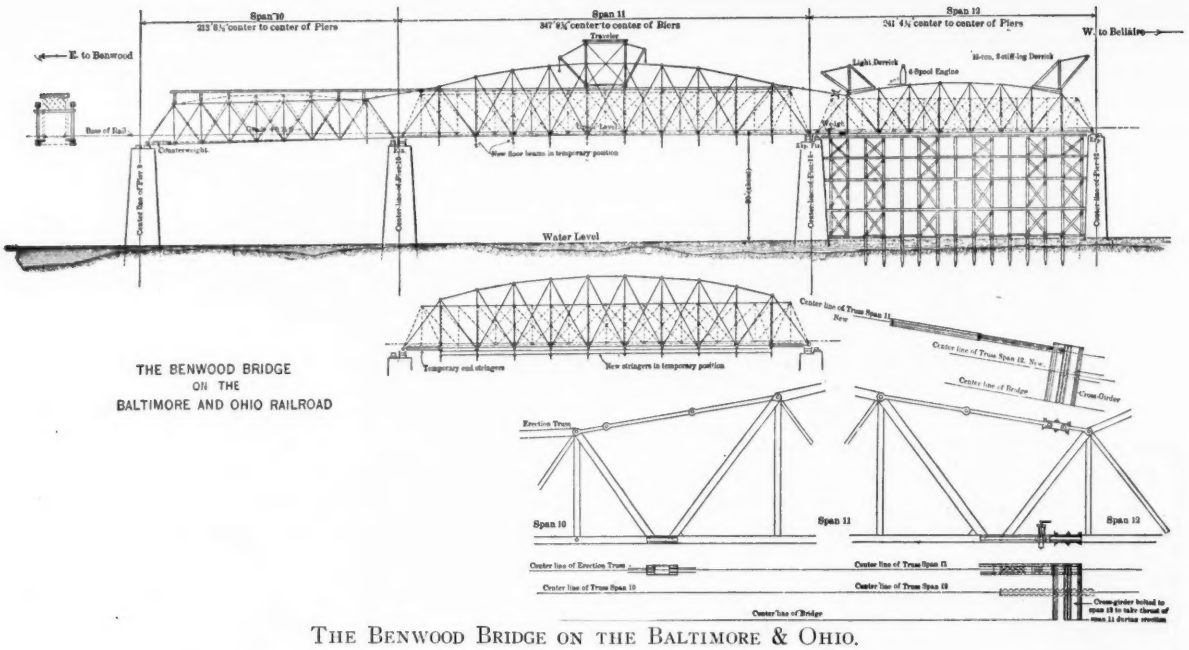
The Bollman spans were built by the Baltimore & Ohio Railroad Company at its Mt. Clare shops, Baltimore. The other spans were built by the Keystone Bridge Company. The first stone was laid in the foundations on May 2, 1868, and the bridge was opened for traffic on June 21, 1871.

The structure was designed for a uniform load of about one ton per foot, with the unit strains in use at that time.

Periods of Reconstruction.

The rebuilding of this bridge was not a continuous operation, but was done in sections extending over a number of years, the policy being to replace those spans which were the most expensive to maintain, or which developed weakness under the existing traffic, in the order in which this weakness was made evident. Each section was designed in accordance with the specification in use on the Baltimore & Ohio Railroad at the time the design was made, the result being that the completed new structure is not of uniform strength.





THE BENWOOD BRIDGE
ON THE
BALTIMORE AND OHIO RAILROAD

THE BENWOOD BRIDGE ON THE BALTIMORE & OHIO.

The periods of renewal were as follows:

Year 1893.—Spans 14 and 15, designed for Consolidation engines weighing 107½ tons with tenders; all materials wrought iron; specifications of 1892; Union Bridge Company, builders.

Year 1900.—Spans 1 to 7, inclusive, designed for Consolidation engines weighing 125 tons with tenders; material, soft open-hearth steel; specifications of 1896; builders, Pencoyd Iron Works.

Year 1902.—Spans, 8, 9, 10 and 13, designed for Cooper's E-50 engines, followed by a train load of 5,000 pounds per running foot; material, soft open-hearth steel; specifications of 1896; builders, Edgemoor Plant, American Bridge Company.

Year 1904.—Spans 11 and 12, designed for Cooper's E-50 engines; material, open-hearth structural steel; specifications of 1901; builders, Edgemoor Plant, American Bridge Company.

The Design.

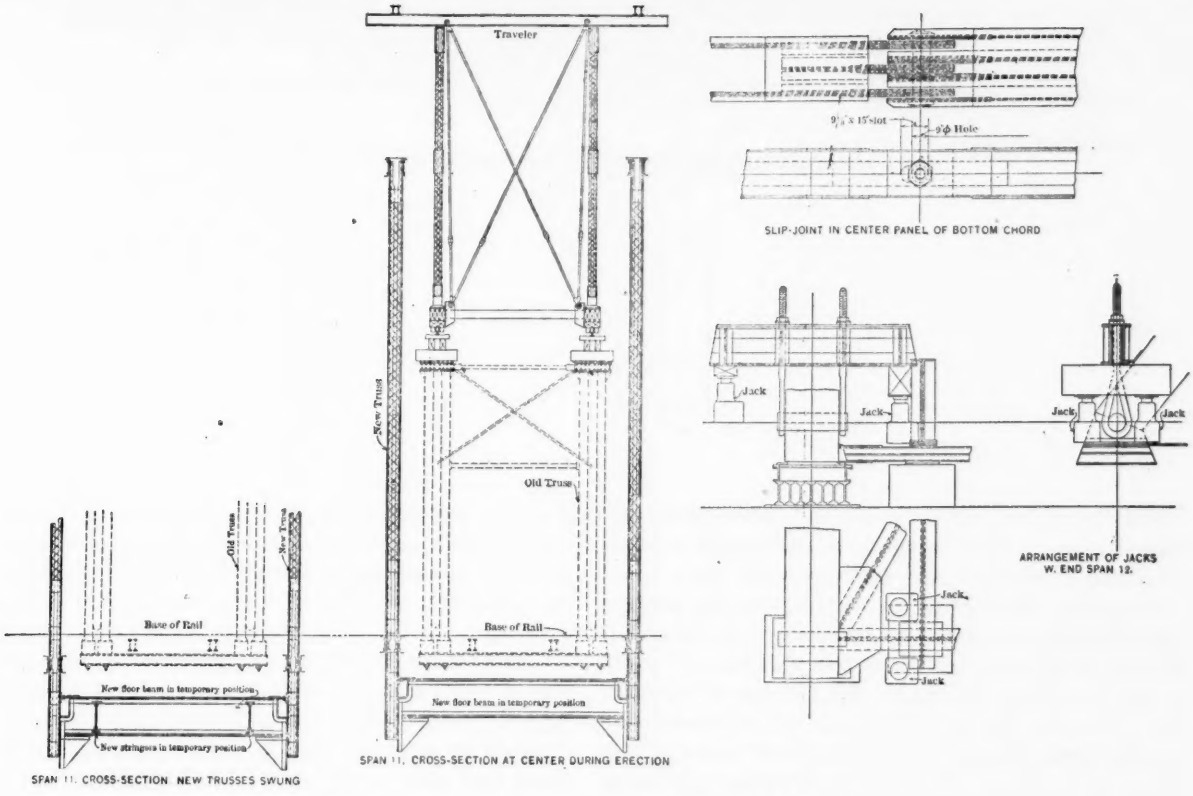
The reconstruction of this bridge, except Spans 11 and 12, involved no work of particular interest, either in the design or in the erection, as there was no objection to the use of falsework. Spans 8, 9, 10 and 13 were made through bridges, instead of deck bridges, as the trusses and overhead bracing could be erected before disturbing the old structure, and in case the falsework had been washed out, there would have been the least possible interruption to traffic.

The design of Spans 11 and 12 was controlled by the proposed method of erection, the requirements being that the erection should be carried on without interrupting the railroad traffic or interfering with navigation in the main channel span (Span 11), there being no objection to falsework under Span 12.

The question of widening the channel was fully considered before the final adoption of the design upon which the structure was actually built. The war department and the river men desired a much larger channel span than existed in the old structure, but there was a still further question as to who should pay for the difference in cost between rebuilding the bridge on the existing masonry and the lengthening out of the span as desired, the railroad company claiming under their charter the right to maintain the bridge on the existing masonry. The railroad company had obtained a special war department permit during 1900 for the reconstruction of Spans 8, 9, 10 and 13 on the existing masonry, and, considering this fact, the war department would probably have been satisfied with the removal of Pier 11 and the replacing of Spans 11 and 12 with one single span of a total length, from center to center of piers, of 589.48 feet, part of which could have been erected on falsework. This would have required extending Piers 10 and 12 and the removal of Pier 11. A study of this plan is shown in Fig. 1. It is estimated that this single span would have cost about $253,500 more than the construction on the existing masonry.

While the war department would probably have agreed to a span of 589.48 feet, they preferred a span giving at least 700 feet in the clear of the piers. This would make a length of 730 feet from center to center of piers. This would have necessitated the removal of three piers, the lengthening out of one pier, the rebuilding of one pier, and the replacing of Spans 9, 10, 11 and 12, with one span of 284.55 feet and one span of 730 feet. A study of this scheme is shown in Fig. 2. It was estimated to cost about $563,000 more than the cost of erecting on the existing masonry.

All of the old bridge having been replaced by this time, with the exception of Spans 11 and 12, and the weakness of these spans being such as to prevent the



THE BENWOOD BRIDGE ON THE BALTIMORE & OHIO.

railroad company from using the heavy cars and locomotives which were in operation on each side of the bridge, it became necessary for the railroad company, in order to get the benefit of their heavy power and equipment, to reconstruct these two spans as speedily as possible, and there being no prospect of the government or the river men paying the additional cost for the increased channel span, and the railroad company not being inclined to bear this extra expense, it was decided to reconstruct these two spans of the existing masonry, care being taken not to interfere with navigation through the main channel. The method of erection, therefore, was the main feature which controlled the design of these spans. As Span 12 could be erected on falsework, this span presented no difficulty, but for Span 11 there were only three apparent methods of erection, as follows:

A. Extend the piers by means of pile bents, erect the new span on floats, jack the old bridge to one side and float the new span into position, and then pick up the old span with the floats, move it to one side and dismantle it.

B. Transfer the Baltimore & Ohio traffic over the Wheeling Terminal bridge, and erect Span 11, using the existing structure in place of falsework.

C. Erect Span 11 on the cantilever principle, Span 12 to be erected on falsework and designed as one shore arm, and a temporary shore arm being placed on the outside of the existing structure in Span 10. In this method, the old Span 11 would be called upon to carry the railroad traffic and at the same time support the erection traveler. Between trains, this old span would support the traveler and such members as the traveler was handling.

Method A was abandoned as impracticable, on account of the frequent variation of the watel level of the Ohio river.

Method B was at first considered favorably on account of the possibility of the Baltimore & Ohio Railroad transferring its traffic over the Wheeling Terminal bridge for a period of 50 or 60 days while Span 11 was being replaced. This scheme was abandoned, on account of the congestion which would result on the Wheeling Terminal bridge, due to the immense volume of business being done at that time.

It was decided, therefore, to proceed with the erection in accordance with Method C. The structure was designed accordingly, and the work was carried through to completion. The following is a brief description of the main features in the design of these two spans:

Span 12 was designed and proportioned so as to take up reversal of stresses while the trusses were acting as cantilever arms during the erection of Span 11.

Span 11 was designed so that the trusses and upper bracing cleared the old span. The floor system and lower laterals, however, could not be made to clear, on account of the fact that the distance from the base of rail to the lowest part of the structure has to remain the same in both cases. The span had a stiff bottom

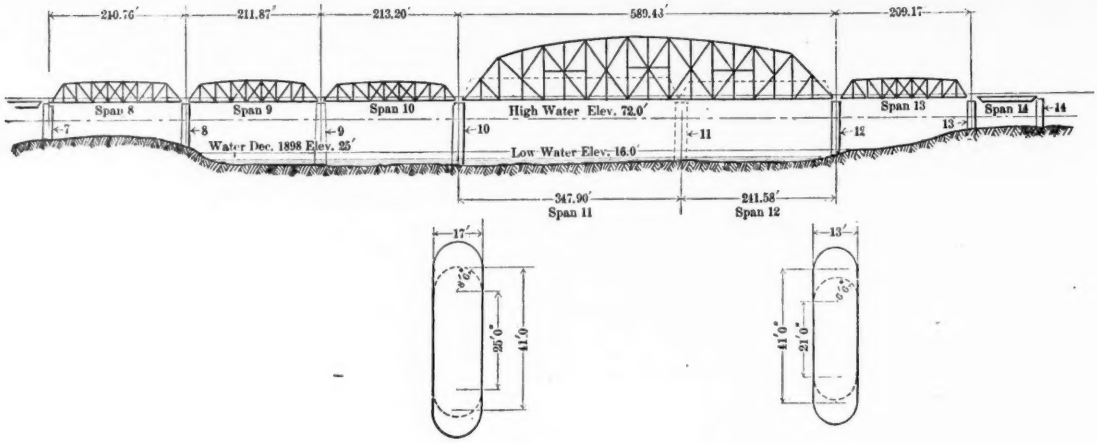


FIG. 1.

chord throughout, all members, of course, being designed to meet the conditions of erection as a cantilever and a free span after erection.

As the existing Span 10 was of a good, modern type of construction, it was not desired to replace it. It had eye-bar bottom chords, and could not be made to act as a shore arm during the erection of Span 11, and it became necessary to design special trusses, extending from Pier 9 to Pier 10, which could act as shore arms during the erection of Span 11. These trusses could be erected on the outside of the existing span, and were designed so that they could be inverted and used as a deck bridge after they had served their purpose during the erection of the Benwood bridge. These erection trusses were to be clamped to the existing span in such a manner that they would be free to move vertically.

The east, or Benwood, end was arranged so that it could be raised or lowered with jacks, as was also the west, or Bellaire, end of Span 12. The erection of Span 11 was to proceed from the piers toward the center, the old truss being relied upon to carry the weight of the traveler and restricted traffic, and the individual members handled by the traveler. The west end of Span 11 was on rollers. Attached to the end bottom pins at this end were struts which connected with cross-girders temporarily attached to Span 12. Each of these struts was in two sections, and these sections bore against a wedge arrangement. An overlap of 2 1-16 inches was provided in the bottom-chord center panel, at low temperature, and about 10 inches clearance of the top-chord center panel, at high temperature. The west end of the center bottom chord was provided with a 9-inch slot, with a maximum movement of 4½ inches each way. The wedge struts at the west end provided for a maximum movement of 8 inches.

It will be seen from the foregoing description that, by jacking up the east end of Span 10 and lowering the wedges in the strut at the west end of Span 11, the top chords at the center of Span 11 could be lowered to their proper bearing; and, if, by some chance, there should not be sufficient movement attainable with the wedge arrangement there was still left an opportunity of jacking up the west end of Span 12 (see Plate XXV).

The Erection.

The method of erection of Spans 11 and 12 (see Plate XXVI) was carried on as outlined in the following:

Span 12.—Falsework was placed under the old span, which was then taken down. The traffic was carried on this falsework while the new span was being erected. The falsework was not removed until Span 11 was swung, as it was required to support the live load, thereby avoiding vibration in the west of Span 11 during erection.

The dead-load positive reaction per truss on Span 12 was 157,000 pounds, and as the erection-stress negative reaction was only 56,000 pounds, no counterweighting was required.

The East Shore Arm. Span 10.—For the east shore arm, the temporary trusses were erected outside of the trusses of Span 10, and on the same line as the trusses in Span 11. They were erected directly from the existing span, without the use of falsework, and were clamped to the existing trusses, the clamps being arranged so as to permit of movement up and down. The east ends of these erection trusses were dropped from about 36 inches below the level. The dead-load positive reaction about equaled the erection-stress negative reaction, and, therefore, provision was made for about 25 tons counterweights for each truss.

Span 11.—The erection of this span was started at the east end, and, as the traveler moved toward the center of the span, the portals, top laterals and as much of the sway bracing as possible were removed. The floor-beams were placed upside down, in a temporary position below the bottom chord pins, and connected to the posts, which were lengthened for this purpose and which were cut off after the floor-beams were placed in their proper position. After the east half was completed as far as the center, and all bracing was placed, the west arm was erected in the same manner,

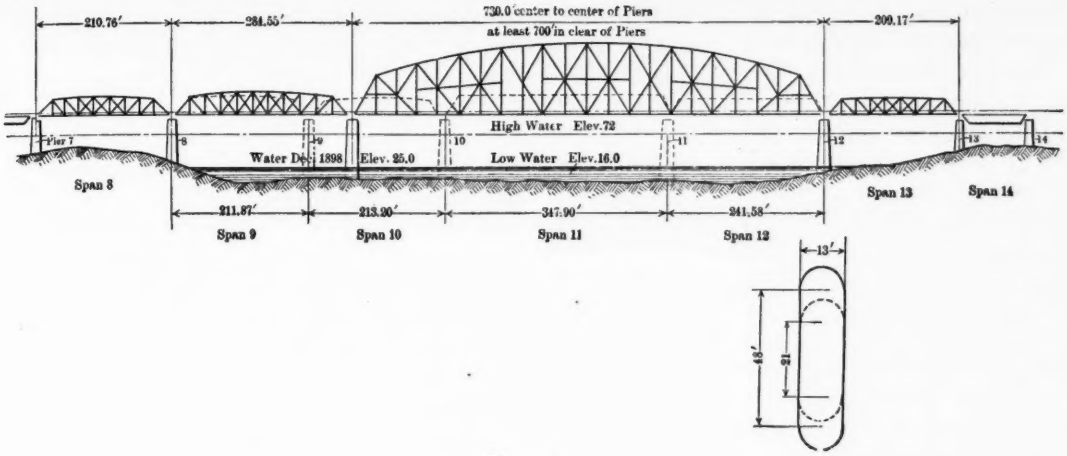


FIG. 2.

connection being made in the center panel of the top and bottom chords.

No difficulty whatever was experienced in connecting the two halves of this span. The east end of Span 10 was jacked up and the wedges at the west end of Span 12 were withdrawn until the members came to their proper position. After this span was swung, the intermediate stringers were placed in their temporary position, under the old trusses, and connected by temporary timber laterals. The old trusses and floor were then blocked up and the trusses and bracing taken down, using the new span for support. The end panels of the laterals were placed in their permanent position, and temporary stringers provided, so as to clear these end laterals.

General.

The traveler used during this erection, as will be observed from the plan, was run on the top chords of the existing bridge. It weighed 40 tons. Nearly all the material was floated out under the spans on barges, then picked up and placed in position by the traveler.

During the erection of Span 11, it was necessary to take the greatest care in placing the traveler in a fixed position during the handling of material, and, before the erection proceeded, the old bridge was carefully adjusted and the posts braced with temporary wooden braces. The maximum tension strains in the old bridge during this erection did not exceed 16,000 pounds per square inch, and the compression strains were in proportion.

As Span 11 was considerably wider than the existing bridge, and as the bearings were rather closer to the ends of the piers than was desired, the masonry was cut down, under traffic, and I-beam grillages were placed on top of the piers, with a view of distributing the weight.

The entire work of erection was conducted in a most careful and satisfactory manner, there being no hitch or errors of any moment, either in workmanship or in judgment, and the successful completion of this dangerous piece of erection, which was of an unusual character, perhaps without precedent, is very creditable, not only to the erection department of the American Bridge Company, but to Foreman J. W. Sweet, who had direct charge of the forces in the field.

Design and Operation of a Modern Freight Yard

Read before the Engineers' Club of Philadelphia, by Joseph T. Richards, Feb. 18, 1905.

THE increasing population, agriculture, manufactures, commerce, and wealth of the United States naturally cause a rapid increase in the traffic thrown upon the railroads for transportation; particularly is this so from the growing west to the east, and burdens the railroads to such an extent that it seems almost impracticable to construct railroad tracks, yards, and terminal facilities fast enough to keep pace with the increased business. It is evident that all the trunk lines east of the Mississippi are behind in their tracks, terminals, and equipment to move and distribute the tonnage of freight offered them.

The Interstate Commerce Commissioners' report for the fiscal year ending June 30, 1903, which is the latest report which has been issued, shows an incrase of 104,078,536 tons of freight carried over the previous year. The total tons of freight carried were 1,304,393,323, the increase in one year being 8.7 per cent of the total. The aggregate number of freight locomotives in service was 25,444, an increase of 1,850 over the previous year, being 7.8 per cent of the total. Freight cars in service, 1,653,782 an increase of 107,681 during

the year, being 6.9 per cent of the total. Total mileage of railroads in the United States was 207,977.22, an increase of 5,505.37 miles for the year, or 2.7 per cent of the total.

From this is shown the increase of miles of road (2.7 per cent), which is given for both freight and passenger service, is low in increase as compared with increased tonnage of trade pressing into the channels of transportation (8.7 per cent)—about 3 to 1.

The cars and locomotives are also low, but not so seriously behind as is shown in the lack of trackage. As to the matter of terminals and yard facilities, I have no data to be taken from the reports of the Interstate Commerce Commission, but they bear quite as important a part as any of the other factors in clearing the channels and adding to the ability of railroads to move freight from end to end of the roads. Through yards are the working facilities en route, and the terminal yards are the working facilities at the end—particularly are the terminals at large cities and when the road ends at the Atlantic seaboard. More especially is the New York harbor the greatest of all to be considered, for the reason that, like Rome, none of the roads run through.

For the terminal in New York harbor you can very well imagine the immense tonnage of freight accumulated by the trunk lines in all the district east of the Mississippi, as you see the busy freight trains moving east and coming to a sudden stop at the waters of New York bay—the task the railroad men have of distributing and unloading cars, some to the piers of New York, others to steamships for export to foreign ports, and others to be transferred by water, to be forwarded to New England. All these cars are to be classified and returned to the west, and so the business continues, increasing about 10 per cent a year, and keeping the railroad companies hard up to the task of providing a terminal to prevent a congestion of their share of the trade at this most important harbor.

For an inland terminal I will give you a short statement of freight in the city of Washington. In eight years the freight business handled by P., B. & W. R. R. has increased 110 per cent. The business taken care of by the P., B. & W. R. R. coming into Washington from southern lines shows that C. & O. freight has increased in eight years 350 per cent, and from the Southern Railway & Atlantic Coast Line in eight years the increase has been 650 per cent.

It has not been possible for our railroad facilities at this place to keep pace with this increased business, and you can well understand how serious the matter of freight and passenger congestion must have been in this city when the P. R. R. and the B. & O. have arranged to spend not less than $7,000,000 to rearrange tracks and terminals and put themselves in position to meet the situation. This is only one of a number of instances that might be mentioned to show the increased tonnage thrown onto the railroads by the growth of the country.

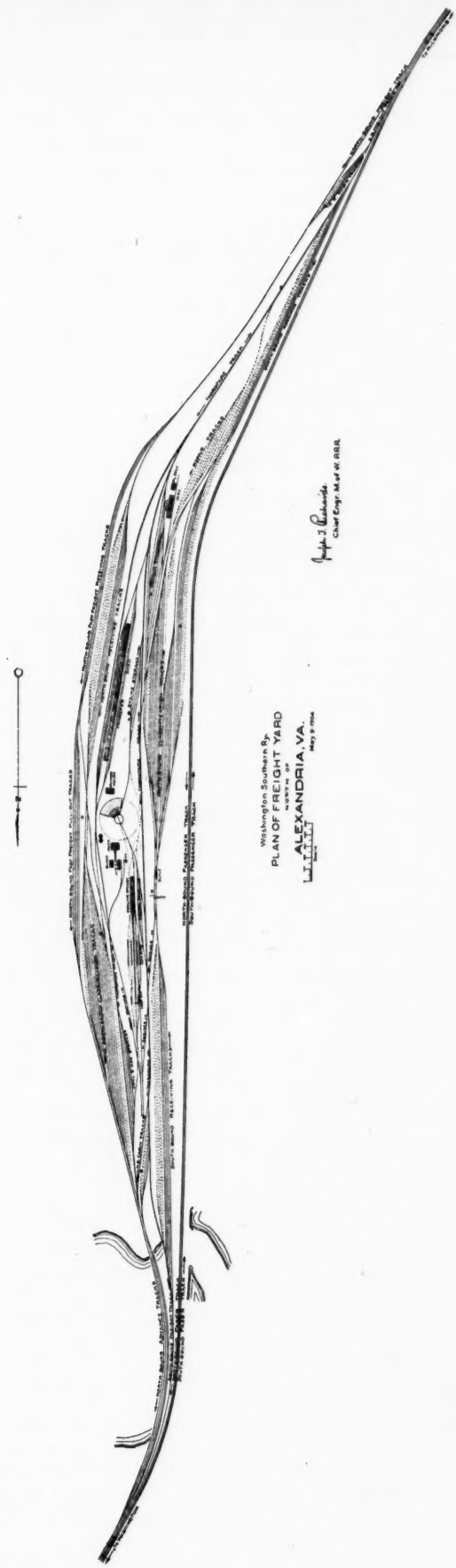
I will now consider a plan for a general yard design and the method of operating it. The proper function of this yard is to pass cars en route through within the least possible time. In common practice yards have their names: A. The receiving yard. B. The classification yard. C. The departure yard. D. The gravity yard—long continuous grade. E. The poling yard—but little if any grade. F. The summit yard (hump), and others of minor importance.

It may be well to state that the ideal railroad is said to be one that has no yards; that is, a train can start at one end and run through to the other without classification. This can be carried out for a great deal of traffic for a railroad, say 100 miles long, but where the length multiplies and the line becomes as long as trunk lines in the United States (we may say from the east to Chicago), it is necessary to change engines and make classification of cars. Therefore the yards come in as a necessary evil. It is a question, then, how to arrange these yards to make the least possible delay, as time in transit is the most important element that railroad transportation and traffic managers have to consider.

We will trace the progress of a freight train coming into and through the several parts of this general freight yard. The train arrives from the road, and, in passing into the receiving yard, the cabin in the rear is cut off, on the lead track, at the switch, leading to the cabin yard; the road engine continues with the train into the receiving yard, and, upon arrival there, cuts loose and goes directly to the engine yard; the cabin, in the meanwhile, having drifted into the cabin yard into a position ready to go out on the road in the opposite direction in its proper turn, the cabin tracks being graded to accomplish this movement. As soon as possible after arrival in receiving yard the train is inspected, the destination in the classification yard of the various cars is marked upon them, as well as the needed repairs to crippled cars which are to be thrown off into a separate track, known as a cripple track, and finally taken to the car repair yard. When the train is ready for classification, a pusher engine gets behind it and gradually pushes it over the "hump," a man stationed there, and known as the "cutter," separates them into "cuts" of from one to ten cars.

In marking the cars for classifications each "cut" of a draft or train is marked with its destination at the front end and the destination of the next succeeding "cut" at the rear end. This is for the benefit of the man in the tower operating the switches, so that he will have sufficient time to set the switches for each "cut" as it comes along. He is also furnished with a check list of each draft or train showing the "cuts" to be made, and the number of cars in each "cut."

The towerman in a two-story tower adjacent to the "hump" from which he can see the entire layout, operates the switches electrically by means of a push button machine, so that the cars will pass to the



proper classification tracks. The speed at which the train is pushed over the "hump" is such that the cars, in running away from the "hump," usually are separated a sufficient distance from each other that they will not foul one another when passing over ladders, but in the event of too many "cuts" following the same ladder and thus getting too close, the tower is equipped with an air-whistle or other signal under control of the towerman, by which he can regulate the speed movement of the pushing train. When a sufficient number of cars have accumulated in the classification yard (say, a train length) for any particular destination, or should the tracks of this yard become full, the cars are pushed out into the advance tracks or starting yard, where they are coupled up into trains and the air tests made. A road engine which has moved from the engine storage tracks couples up to the cars as they stand on the advance tracks and pulls the train out on the main track, and in passing by the cabin yard a cabin is dropped out by gravity and coupled up to the rear of the train. The above process applies to trains in both directions through the yard. The cars pass over the "hump" at the rate of about eight a minute under ordinary conditions. To pass a freight train of, say, 80 cars through a yard as above stated, from the time of entering the receiving yard to leaving the departing yard, should not require more than two or three hours.

We will now follow the incoming road engine after it leaves the train in the receiving yard. It first passes to the inspection pit, where a thorough inspection is given it, and, if repairs are necessary, a message is sent to the round-house that Engine No. —— will be placed in the round-house for certain repairs. This gives the round-house foreman an opportunity to have a stall ready to receive this engine. The inspection requires about five minutes. From the inspection pit the engine passes to the ash pit, where the fires and the front end are cleaned, requiring, on an average, thirty minutes. The engine then passes alongside the coal wharf, where it receives its coal, taking up about one and one-half minutes; sand is then taken on at the far end of the coal wharf, and water at this same point. It takes from 1 to 2 minutes to fill the tank with water with the proper size standpipe. The engine then passes to the turntable, and if it is to be housed for repairs, it is placed in the round-house. If no repairs are necessary, it is turned quickly and sent direct to the engine storage yard, where it awaits a call for power for a return train on the division from which it arrived. The average total time taken by an engine, where no repairs are made, from when it cuts loose from its train in the receiving yard until it is ready to take a train out on the road again, would not exceed one and one-half hours in a properly arranged yard. When a yard is not properly planned, an engine will take from four to six hours to make the same movement.

Personals

Mr. Murray Harris has been appointed roadmaster of the Texas & Pacific at Marshall, Tex.

Mr. Henry L. Fry, engineer maintenance of way of the Southern at Greensboro, N. C., died on April 5 at the age of 54 years.

Mr. L. H. Barker has resigned as assistant chief engineer of the Pennsylvania Railroad on account of ill health.

Mr. H. Pierce, superintendent of the Greenbrier division of the Chesapeake & Ohio, has been appointed engineer of construction of that road.

Mr. L. Laden, formerly roadmaster of the Chicago division of the Illinois Central, has been appointed assistant to the assistant chief engineer.

Mr. Webb C. Ball has been appointed general time inspector of the Toledo, St. Louis & Western, with headquarters at Cleveland, O.

Mr. J. K. Troufe has been appointed engineer maintenance of way of the Toledo, St. Louis & Western, with headquarters at Frankfort, Ind.

Mr. A. W. Munster, formerly acting chief engineer of the Chicago Great Western, has been appointed chief engineer of that road, with headquarters at St. Paul, Minn.

Mr. G. H. McDonough has been appointed signal engineer of the entire system of the Cleveland, Cincinnati, Chicago & St. Louis.

Mr. S. S. Roberts, formerly roadmaster of the Louisville & Nashville at Elizabethtown, Ky., has been appointed assistant engineer and roadmaster of the Louisville terminals at Louisville, Ky.

Mr. Frank C. Faust has been appointed chief engineer of the Missouri, Oklahoma & Gulf, with headquarters at Muskogee, I. T., to succeed Mr. George F. Morse, resigned.

Mr. Eldridge Whiting, who was formerly engineer in charge of the construction of the St. Joseph & Denver City Railroad, now the St. Joseph & Grand Island, died at Laramie, Wyo., on March 31, aged 83 years.

Mr. Fred S. Darling, division engineer of construction of the Canadian Pacific at Montreal, has been transferred to Toronto, Ont., where he will have charge of the construction of the branch from Toronto to Sudbury.

Mr. L. P. Atwood, formerly superintendent and chief engineer of the Rio Grande, Sierre Madre & Pacific, has been appointed engineer maintenance of way of the Chicago, Peoria & St. Louis, with headquarters at Springfield, Ill.

Mr. E. W. Layfield has been appointed chief engineer of the Chicago Terminal Transfer Railroad, with headquarters at Chicago, vice Mr. F. E. Paradis, resigned to engage in the private practice of his profession.

Mr. Lawrence Griffeth, formerly engineer maintenance of way of the Grand Central Station and Harlem line of the New York Central & Hudson River, has resigned to become vice-president of the Federal Railway Signal Company of New York.

Mr. D. J. Brumley, division engineer of construction of the Indianapolis Southern, has been appointed principal assistant engineer of the Illinois Central, in charge of construction, with headquarters at Chicago, to succeed Mr. H. R. Safford, appointed assistant chief engineer.

Mr. D. W. Fagley, Jr., has been appointed assistant supervisor of the Pennsylvania Railroad at Wilkesbarre, Pa., in place of Mr. C. H. Rickey, transferred. Mr. E. L. Watson has been appointed supervisor of signals of the Baltimore division at Baltimore, Md. Mr. G. H. English has been appointed supervisor of the Northern Central at Shamokin, Pa., vice Mr. C. E. Heritage, transferred.

Award of Medals of Honor

Regulations Governing the Award of Life-Saving Medals Under Public Act Number 98, Approved February 23, 1905.

1. Applications for medals under this act should be addressed to and filed with the Interstate Commerce Commission, at the city of Washington, D. C. Satisfactory evidence of the facts upon which the application is based must be filed in each case. This evidence should be in form of affidavits made by eyewitnesses, of good repute and standing, testifying of their own knowledge. The opinion of witnesses that the person for whom an award is sought acted with extreme daring and endangered his life is not sufficient, but the affidavits must set forth the facts in detail, and show clearly in what manner and to what extent life was endangered and extreme daring exhibited. The railroad upon which the incident occurred, the date, time of day, condition of the weather, the names of all persons present when practicable, and other pertinent circumstances should be stated. The affidavits should be made before an officer duly authorized to administer oaths, and be accompanied by the certificate of some United States official of the district in which the affiants reside, such as a judge or clerk of United States court, district attorney, or postmaster, to the effect that the affiants are reputable and credible persons. If the affidavits are taken before an officer without an official seal, his official character must be certified by the proper officer of a court of record under the seal thereof.

2. Applications for medals, together with all affidavits and other evidence received in connection therewith, shall be referred to a committee of five persons, consisting of the Secretary of the Commission, the chief inspector of safety appliances, two inspectors of safety appliances designated by the Commission, and the clerk of the safety-appliance examining board, who shall act as clerk of the committee. This committee shall carefully consider each application presented, and, after thoroughly weighing the evidence, shall prepare an abstract or brief covering the case, and file the same, together with the committee's recommendation, with the Commission, which brief and recommendation shall be transmitted by the Commission to the President for his approval. The committee may, with the approval of the Commission, direct any inspector of safety appliances in the employ of the Commission to proceed to the locality where the service was performed for which a medal is claimed, and make a personal investigation and report upon the facts of the case, which report shall be filed and made a part of the evidence considered by the committee.

3. Upon final approval of the committee's recommendation by the President the Commission shall take such measures to carry the recommendation into effect as the President may direct.

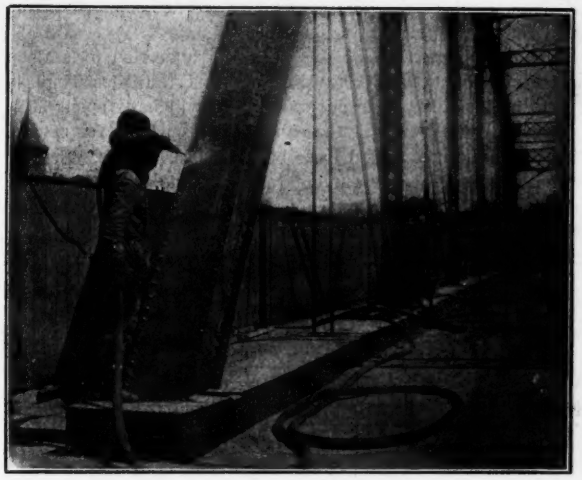
4. The Commission shall cause designs to be prepared for the medal, rosette, and ribbon provided for by the act, which designs shall be submitted to the President for his approval.

Theodore Roosevelt.

The White House, March 29. 1905.

Sand Blasting--Boston & Maine Railroad

The accompanying illustration shows a sand blast apparatus in operation on one of the bridges of the Boston & Maine Railroad. The mixed air and sand is delivered through a rubber hose to a nozzle, through which the sand is directed upon the work. A uniform grade of dry sand with sharp cutting edges is used. In this manner an absolutely clean surface for painting is obtained. Immediately following this thorough cleaning, the metal receives a well-applied coat of Dixon's Silica-Graphite Paint, which furnishes excellent protection for many years against corrosion.—(From April Graphite.)



SAND BLASTING—BOSTON & MAINE RD.

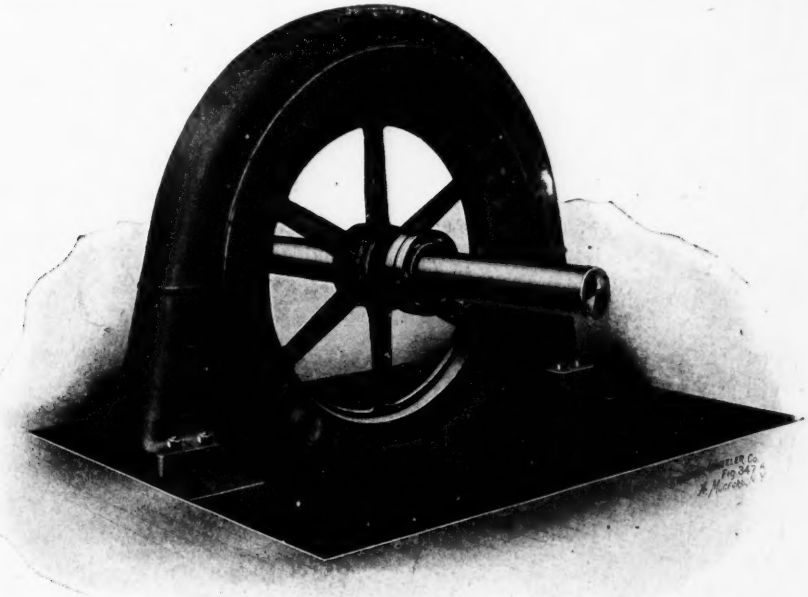
Crocker-Wheeler 4,000 K. V. A. Alternates for the Chicago Sanitary District

An order for four 4,000 K. W. three phase, sixty cycle, 6,600 volt alternating current generators, with exciters, has just been placed with the Crocker-Wheeler Company, Ampere, N. J., by the Trustees of the Sanitary District of Chicago. These are to be driven by Wellman-Seaver-Morgan horizontal water-wheels and put in operation at Lockport, Ill., the western end of the Chicago sanitary and ship canal. The two exciters for these machines will also be water-wheel driven and of 350 K. W. capacity at 300 R. P. M.

The contract was awarded the Crocker-Wheeler Company, the American licenses of the celebrated alternating current engineers, Brown, Boverie & Cie, of Baden, Switzerland, in competition with the leading electrical manufacturers of America. It is less than a year ago that the Crocker-Wheeler Co., long established in the field of direct current manufacture, began to market a line of alternating current generators for operation with every description prime mover. It will be recalled that the California Gas & Electric Corporation recently placed an order for three 4,000 K. V. A. alternating current generators, to be driven by gas engines, which will supply current for all the street railways in San Francisco.

Six years ago the Chicago Sanitary and Ship Canal, which is more than twenty-eight miles long, and designed primarily to convey the sewage of Chicago to the Desplaines and Illinois rivers and so to the Mississippi, was opened and filled with water from Lake Michigan. Since then it has been performing its sanitary function.

Since June, 1895, Mr. Isham Randolph, formerly president of the Western Engineering Association, has had in hand this great project of tapping the Great Lakes at their southern end. His present work is centered at Lockport, where the mean head for water power development, when the present improvements are completed, will be 32 feet and the net power 40,000 H. P. The ultimate discharge of the canal will be 800,000 cubic feet per minute. A structure of concrete and brick construction will house the power; and provision will be made for eight generator units, four of which are



CROCKER-WHEELER GENERATOR.

now under contract. The power generated at Lockport will be used for municipal lighting in Chicago.

The third great use of the canal, as a section of a deep waterway connecting Lake Michigan and the Mississippi is yet to be realized. The city of Chicago will have spent $55,000,000 on this canal. If the canal had been built for sanitation alone the cost would have been $18,000,000 less. Whether or not the Federal Government takes up this work and completes this link between the Great Lakes and the Gulf of Mexico, the Chicago Sanitary and Ship Canal may well be called "the greatest artificial waterway ever constructed."

Notes of the Month

The program of the regular monthly meeting of the Northwest Railway Club, held in St. Paul, April 11, included a paper on "Concrete Construction and Consistency in its Reinforcement," by Mr. Louis F. Brayton.

The Burlington-Northern Pacific Lewis and Clark Good Roads Special will start from Chicago May 3 under the direction of Colonel W. H. Moore, president of the National Good Roads Association. Prominent government and national road officials will accompany the train. It will also carry a corps of the most prominent experts and road engineers in the world, who will teach the people how to construct roads and streets of the greatest durability at the least possible cost with the materials at hand. The object of this itinerary is to hold forty or more local and state conventions at central points between Chicago and Portland.

The Pennsylvania Railroad has awarded the contract for the construction of the twin tunnels through the Bergen Hills at Hoboken, N. J., to the John Shields Co., of New York, with the stipulation that work shall begin at once. The financial consideration involved in the contract is not made public, but it is understood to be near $2,250,000. These tunnels will be about 1¼ miles in length and will be the connecting link between the Meadows and the tunnels under the Hudson river, the construction of which is now under way. This work has been timed so as to bring to a simultaneous completion the entire engineering project by which the Pennsylvania is to enter New York City.

Bulletin No. 2 of the Otto Gas Engine Works, 360 Dearborn St., Chicago, describes "How to Handle Water for the Locomotive with Improved Fixtures." The use of a stand pipe, with a tank at some distance from the track, where it will not obstruct the view of signals, and will obviate the formation of a pile of ice dangerously near the track in winter, is the method of supplying water to locomotives recommended in this catalogue. The Otto stand pipe is illustrated in detail, with instructions for connecting up. Otto fixtures for tanks close to the track are also included, as well as a new balanced Otto tank valve, the Snow-Milne slow-closing valve device, the Halladay outlet valve, and the Snow-Milne outlet valve and cushion device.

The Cape-to-Cario Ry. is making rapid progress with the extension northward from Victoria Falls, and there is every reason to believe that the head will be at Kalomo, the administrative center of Northwest Rhodesia (Barotseland), before next June. The further extension of the line for a distance of 250 miles beyond Kalomo will be taken in hand by the Mashonaland Ry., which is working the line from Umtali, Salisbury, Bulawayo and northward, and the terminus of the new extension at Broken Hill will be reached early next year. There will then be continuous railway communication from Capetown to within 100 miles of the southeast corner of the Congo Free State, a total distance of some 2,000 miles. On the Victoria Falls-Kalomo section 50 miles of grading is finished and at least 25 miles of rails laid.

The Danville Structural Tool Co., Danville, Pa., has at their works a machine for breaking rails, which was designed as a substitute for a shearing machine, the advantage being that it will break rails into pieces of accurate length about twice as fast as they can be sheared. The machine is arranged on a horizontal bed with a fly wheel of heavy construction, and weighs 15,000 lbs. It is electrically driven, the gearing running continuously. There is a plunger making 12 to 15 strokes per minute. Normally this plunger works idly at the rear of a plunger head, which remains stationary until a long wedge is inserted between the two, when the plunger head is moved forward to strike the rail at mid span of two supports. When the rails are not to be broken to exact length the wedge remains inserted and the plunger works continuously.

The Cement Department of the Illinois Steel Co., Chicago, has been distributing complimentary copies of a pamphlet entitled "Facing and Finishing Exposed Concrete Surfaces." The matter contained has been reprinted from the book on ((Reinforced Concrete," by A. W. Buel and C. S. Hill. This pamphlet explains the causes of roughness and discoloration of concrete and gives instructions as to the proper construction of forms for molding the face of the concrete to a proper surface. The book takes up the subject of mortar or grout facing and explains methods of placing the material as the concrete is deposited. The use of mouldings and ornamental shapes is discussed, and the efflorescence of lime compounds on the surfaces of concrete work, causing an uneven color, is treated. This same company has reprinted the report of the committee on standard specifications for cement presented to the American Society for Testing Materials at its annual meeting, June 17, 1904.

An occurrence that is believed to be without a parallel in the annals of tunnel engineering was the blowing out of the roof of the subway tunnel under the East river on March 27, due to the pressure of compressed air, which had a sufficient force to blow a hole four feet in diameter through 17 feet of silt, over which was 10 feet of water, sending a column of mud and water to the height of 25 feet above the water level. The most peculiar feature of this affair is that one of the men in the tunnel, who was in the act of placing in the aperture, just then showing, a pluging bag filled with hay and hair, that had been prepared for incipient leaks, was blown through the mud and water and far above the surface of the river, and picked up unharmed and in full possession of his faculties. The blow-out occurred on the Brooklyn side of the river, and is the third one during the prosecution of the work of this tunnel, but the other two were overcome by the bag remedy. While the usual caution is supposed to have been exercised to prevent the trouble experienced, it is evident that the resistance of the silt and water was ess than expected.

Sanitary Conditions on the Isthmus of Panama. Reply of the Isthmian Canal Commission to the report of Dr. C. A. L. Reed, with letters of the President and Secretary of War; 63 pages.

Development of the Lake Superior Copper Mines During 1905. By Arthur C. Carnahan, mining editor of the Daily Mining Gazette. Published by the author; 37 pages. Price 50 cents.